

亞洲大學

112 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

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

Approved by the University Curriculum Committee on 26/04/2023

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	
University Required (6)Credits	博士論文	Doctoral Dissertation	1 st	2 nd	3	0		
	博士論文	Doctoral Dissertation	2 nd	1 st	3	0		
Program Required (3)Credits	論文研討(一)	Seminar I	1 st	1 st	1	1		
	論文研討(二)	Seminar II	1 st	2 nd	1	1		
	論文研討(三)	Seminar III	2 nd	1 st	1	1		
Program Elective (15)Credits	醫學工程概論	Introduction to Biomedical Engineering	1 st / 2 nd	1 st / 2 nd	3	3		
	醫學影像基本原理與儀器	Basic Theories of Biomedical Images and instruments	1 st / 2 nd	1 st / 2 nd	3	3		
	生醫感測技術概論	Introduction to Biosensing Technology	1 st / 2 nd	1 st / 2 nd	3	3		
	醫療器材開發	Introduction to Medical Device Development and Regulation	1 st / 2 nd	1 st / 2 nd	3	3		
	生醫材料概論	Introduction to Biomaterials	1 st / 2 nd	1 st / 2 nd	3	3		
	分子生物學	Molecular Biology	1 st / 2 nd	1 st / 2 nd	3	3		
	生物資訊學	Bioinformatics	1 st / 2 nd	1 st / 2 nd	3	3		
	生物化學	Biochemistry	1 st / 2 nd	1 st / 2 nd	3	3		
	體學	Omics	1 st / 2 nd	1 st / 2 nd	3	3		
	細胞生物學	Cell Biology	1 st / 2 nd	1 st / 2 nd	3	3		
	系統生物學	Systems Biology	1 st / 2 nd	1 st / 2 nd	3	3		
	機器學習	Machine Learning	1 st / 2 nd	1 st / 2 nd	3	3		
	生物技術導論	Introduction to Biotechnology	1 st / 2 nd	1 st / 2 nd	3	3		
	藥物設計概論	Introduction to Drug Design	1 st / 2 nd	1 st / 2 nd	3	3		
	生醫訊號處理	Biomedical Signals Processing	1 st / 2 nd	1 st / 2 nd	3	3		
	資料探勘	Data Mining	1 st / 2 nd	1 st / 2 nd	3	3		
	生醫影像處理	Biomedical Image Processing	1 st / 2 nd	1 st / 2 nd	3	3		
	生物資訊演算法	Bioinformatics Algorithms	1 st / 2 nd	1 st / 2 nd	3	3		
	計算分子生物學	Computational Molecular Biology	1 st / 2 nd	1 st / 2 nd	3	3		
	高等資料庫系統	Advanced Database Systems	1 st / 2 nd	1 st / 2 nd	3	3		
生物資訊程式設計	Bioinformatics Programming	1 st / 2 nd	1 st / 2 nd	3	3			
分子演化	Molecular Evolution	1 st / 2 nd	1 st / 2 nd	3	3			

	生物資訊統計分析	Statistical Analysis in Bioinformatics	1 st / 2 nd	1 st / 2 nd	3	3		
	仿生計算	Biologically Inspired Computing	1 st / 2 nd	1 st / 2 nd	3	3		
	生物技術專題講座(一)	Biotechnology Seminar I	1 st / 2 nd	1 st / 2 nd	3	3		
	生物技術專題講座(二)	Biotechnology Seminar II	1 st / 2 nd	1 st / 2 nd	3	3		
	類神經網路	Artificial Neural Networks	1 st / 2 nd	1 st / 2 nd	3	3		
	生醫光學概論	Introduction to Biooptics	1 st / 2 nd	1 st / 2 nd	3	3		
	機器人計算學	Robotic Computing	1 st / 2 nd	1 st / 2 nd	3	3		
	醫療器材創新啟蒙	Innovation and Design of Medical Device	1 st / 2 nd	1 st / 2 nd	3	3		
	生醫材料專論	Special Topic in Biomaterials	1 st / 2 nd	1 st / 2 nd	3	3		
	材料分析	Characterization and Analysis of Materials	1 st / 2 nd	1 st / 2 nd	3	3		
	臨床工程概論	Introduction to clinical engineering	1 st / 2 nd	1 st / 2 nd	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	<p>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.</p>
Bioinformatics 生物資訊學	<p>This course covers the following topics: sequence alignment, dynamics programming, NCBI database, gene annotation, gene prediction, molecular phylogenetics, protein structure, and RNA structure.</p>
Introduction to Biomaterials 生醫材料概論	<p>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.</p>
Bioinformatics Algorithms 生物資訊演算法	<p>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.</p>
Introduction to Biooptics 生醫光學概論	<p>This course is designed for the students who does not have basic knowledge of bio-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.</p>
Biotechnology	<p>This course is designed for non-biology students, such as from computer science,</p>

Seminar (I) (II) 生物技術專題 講座(一)(二)	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	This course introduces the design and application of medical devices, and include

<p>to Medical Device Development and Regulation 醫療器材開發</p>	<p>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.</p>
<p>Molecular Biology 分子生物學</p>	<p>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.</p>
<p>Omics 體學</p>	<p>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.</p>
<p>Robotic Computing 機器人計算學</p>	<p>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.</p>
<p>Seminar (I)(II)(III) 專題討論(一)(二)(三)</p>	<p>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.</p>
<p>Systems Biology 系統生物學</p>	<p>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</p>

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
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