

**The Chinese University of Hong Kong**  
**Faculty of Engineering & Faculty of Science**

Summer Courses 2022  
Course Outline

***STEM1050 Micro-and Nano-technology for Biosensing***  
**微納生物傳感技術**

**Introduction:**

Micro- and nano-technology allows the manipulation of matter on a near-atomic scale (~1 billionth of a meter!) to produce new structures, materials and devices. At the micro- and nano-scale, materials begin to exhibit unique properties that affect physical, chemical, and biological behaviors, which may provide unprecedented opportunities for frontier medical research to detect biomolecules effectively and to study the properties of biomolecules in details.

微納技術可在近原子尺度（約十億分之一米）上操縱物質，以創造新的結構、材料和設備。不同材料在微米和納米尺度上會展現出影響其物理、化學和生物行為的獨特性質，這可以為前沿醫學深入研究生物分子性質以及實現有效檢測提供前所未有的機會。

**Medium of Instruction:** English supplemented with Cantonese

**Organising Unit:** Faculty of Engineering & Faculty of Science

**Teacher:** Prof. GAO Zhaoli  
Department of Biomedical Engineering, CUHK  
Email: [zlgao@cuhk.edu.hk](mailto:zlgao@cuhk.edu.hk)

Prof. DINH Ngoc Duy  
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Dr. SIOW Lam Nina  
School of Life Sciences, CUHK  
Email: [nina@cuhk.edu.hk](mailto:nina@cuhk.edu.hk)

**Course content:**

15 August 2022 (Monday)  9:30 am – 12:30 pm 1:30 pm – 4:30 pm	<b><u>Lecture:</u></b> <ul style="list-style-type: none"><li>• Molecular basis of life: Macromolecules and molecular interactions</li></ul> <b><u>Lab:</u></b> <ul style="list-style-type: none"><li>• From gene to protein; DNA and protein structures in 3D (lecture and computer lab)</li></ul>
16 August 2022 (Tuesday)  9:30 am – 12:30 pm 1:30 pm – 4:30 pm	<b><u>Lecture:</u></b> <ul style="list-style-type: none"><li>• Recombinant technology: Gene and protein engineering</li></ul> <b><u>Lab:</u></b> <ul style="list-style-type: none"><li>• Determination of gene expression by real time PCR</li></ul>
17 August 2022 (Wednesday)  9:30 am – 12:30 pm 1:30 pm – 4:30 pm	<b><u>Lecture:</u></b> <ul style="list-style-type: none"><li>• The immune responses: Antibody-mediated immunity and cell-mediated immunity</li></ul> <b><u>Lab:</u></b> <ul style="list-style-type: none"><li>• Analyzing protein by ELISA</li></ul>
18 August 2022 (Thursday)  9:30 am – 12:30 pm 1:30 pm – 4:30 pm	<b><u>Lecture:</u></b> <ul style="list-style-type: none"><li>• The role of biotechnology in COVID-19 pandemic</li></ul> <b><u>Lecture:</u></b> <ul style="list-style-type: none"><li>• Introduction of Nanobiotechnology</li></ul>
19 August 2022 (Friday)  9:30 am – 12:30 pm 1:30 pm – 4:30 pm	<b><u>Lecture:</u></b> <ul style="list-style-type: none"><li>• Fabrication and Characterization of Nanomaterials and Devices</li></ul> <b><u>Lab:</u></b> <ul style="list-style-type: none"><li>• Wearable Ion-Selective Sensors</li></ul>
22 August 2022 (Monday)  9:30 am – 12:30 pm 1:30 pm – 4:30 pm	<b><u>Lecture:</u></b> <ul style="list-style-type: none"><li>• Biosensing and Bioelectronics (applications of bioengineered materials and bioelectronics)</li></ul> <b><u>Lecture:</u></b> <ul style="list-style-type: none"><li>• Introduction of microfluidic chip for detecting the bio-molecular (protein/DNA/RNA)</li></ul>
23 August 2022 (Tuesday)  9:30 am – 12:30 pm 1:30 pm – 4:30 pm	<b><u>Lecture:</u></b> <ul style="list-style-type: none"><li>• The principle of point-of-Care Diagnostics (Covid19 fast diagnostics) &amp; Fabrication of Microfluidic Chips</li></ul> <b><u>Lab:</u></b> <ul style="list-style-type: none"><li>• Covid19 antibody kit test/Pregnancy Kit Test</li></ul>
24 August 2022 * (Wednesday)  9:30 am – 12:30 pm 1:30 pm – 4:30 pm	Make-up Class

<b>Duration</b>	7 whole day sessions (total 42 contact hours)
<b>Date</b>	15-19, 22-23 August 2022 24 August 2022* (make-up class)
<b>Time</b>	9:30 am – 12:30 pm & 1:30 pm – 4:30 pm
<b>Teaching Mode<sup>#</sup></b>	Face to Face (The Chinese University of Hong Kong)
<b>Enrollment</b>	30
<b>Expected applicants</b>	Students who are studying S4-S6 or equivalent who must have taken at least Biology and Physics and preferably the following science courses, including Chemistry, Combined Science, Information and Communication Technology, Design and Applied Technology, Mathematics Extended Module 1 or 2
<b>Tuition Fee</b>	HKD 3,500.00 Students who attend all the sessions will have \$500 scholarship
<b>Credit</b>	2 University Unit Certificate will be issued to students who fulfill the course requirement, i.e. pass in assessment and attain 75% attendance

\* This date is reserved for make-up classes in case there is any cancellation of classes due to unexpected circumstances.

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The Chinese University of Hong Kong  
Faculty of Science  
Science Academy for Young Talent

Summer Courses 2022  
Course Outline

*CUSA1071 How Chemistry Works*  
*化學的真相*

**Introduction:**

This course is designed for students to learn about some fundamental chemical principles. Students will learn the basic principles of chemistry including atoms and molecules, structure and chemical bondings, molecular geometry and properties. This course is conducted in the format of lecture.

本課程的設計旨在讓同學學到一些基礎化學原理。同學會在課程中學到基礎化學原理如原子與分子、結構與化學鍵合、分子幾何及特性。課程以講課形式進行。

**Medium of Instruction:** Cantonese supplemented with English (and written materials in English)

**Organising Unit:** Department of Chemistry, Faculty of Science, CUHK

**Teachers:** Dr. Mak Kin Wah  
Department of Chemistry, CUHK  
Rm. 355, Science Centre South, CUHK  
Tel: 3943 8136, Email: [kendrewmak@cuhk.edu.hk](mailto:kendrewmak@cuhk.edu.hk)

**Course Content:**

22 August 2022 (Monday)  9:30 am – 12:30 pm 2:00 pm – 5:00 pm	<b><u>Lecture:</u></b> Atoms and molecules, structure and chemical bondings (1)  <b><u>Assessment:</u></b> Short-answer exercise
24 August 2022 (Wednesday)  9:30 am – 12:30 pm 2:00 pm – 4:00 pm	<b><u>Lecture:</u></b> Atoms and molecules, structure and chemical bondings (2)  <b><u>Assessment:</u></b> Short-answer exercise
25 August 2022* (Thursday)  9:30 am – 12:30 pm 2:00 pm – 5:00 pm	Make-up Class

<b>Duration</b>	2 day sessions (total 11 contact hours)
<b>Date</b>	22, 24 August 2022 25 August 2022* (make-up class)
<b>Time</b>	9:30 am – 12:30 pm and 2:00 pm – 4:00/5:00 pm
<b>Teaching Mode<sup>#</sup></b>	Face to Face (The Chinese University of Hong Kong)
<b>Enrollment</b>	24
<b>Expected Applicants</b>	Students who are studying S1-S3 (in the academic year 2021-2022)
<b>Tuition Fee</b>	HKD 2,310.00
<b>Credit</b>	0.75 Academy Unit Certificates or letters of completion will be awarded to students who attain at least 75% attendance.

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**The Chinese University of Hong Kong  
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Summer Courses 2022  
Course Outline

***CUSA1081 Some Amazing Discoveries in Science:  
Principles behind, their Importance, and their Applications***  
**科學中的一些精彩發現：其背後的原理、重要性及應用**

**Introduction:**

This course covers the stories of some discoveries in science. Students will learn the principle behind, the importance of the discoveries, their applications and the science of a lot of related topics. Topics included: atomic and molecular structure, chemical bonding, fake gold, X-ray, radioactive decay, nuclear reactions, fluorescence and phosphorescence, noble gases, the father of organic chemistry, polymers, chemical analysis (physical methods, elemental analysis, and chromatography), etc. This course is conducted in the format of lecture, supplemented with demonstrations as well as in-class and at-home activities.

本課程涵蓋了一些科學發現的故事。學生將學習其背後的原理、重要性、應用及許多相關主題的科學。主題包括：原子和分子結構、化學鍵、假金、X射線、放射性衰變、核反應、熒光和磷光、惰性氣體、有機化學之父、聚合物、化學分析（物理方法、元素分析及色譜）等。本課程以講課形式進行，輔以示範以及課堂和居家活動。

**Medium of Instruction:** Cantonese supplemented with English (and written materials in English)

**Organising Unit:** Department of Chemistry, Faculty of Science, CUHK

**Teachers:** Dr. Cheung Yu San  
Department of Chemistry, CUHK  
Rm. 234, Science Centre North, CUHK  
Tel: 3943 6265, Email: [yscheung@cuhk.edu.hk](mailto:yscheung@cuhk.edu.hk)

**Course Content:**

<p>15 August 2022 (Monday)</p> <p>9:30 am – 12:30 pm 2:00 pm – 5:00 pm</p>	<p><b><u>Lecture:</u></b></p> <ul style="list-style-type: none"> <li>• “All that glitters is not gold”</li> <li>• The discovery of X-ray</li> <li>• The discovery of radioactivity</li> </ul> <p><b><u>Assessment:</u></b></p> <ul style="list-style-type: none"> <li>• Short-answer exercise</li> </ul>
<p>17 August 2022 (Wednesday)</p> <p>9:30 am – 12:30 pm 2:00 pm – 5:00 pm</p>	<p><b><u>Lecture:</u></b></p> <ul style="list-style-type: none"> <li>• Cold fusion</li> <li>• Noble gases</li> <li>• The father of organic chemistry</li> </ul> <p><b><u>Assessment:</u></b></p> <ul style="list-style-type: none"> <li>• Short-answer exercise</li> </ul>
<p>19 August 2022 (Friday)</p> <p>9:30 am – 12:30 pm 2:00 pm – 5:00 pm</p>	<p><b><u>Lecture:</u></b></p> <ul style="list-style-type: none"> <li>• Polymers</li> </ul> <p><b><u>Assessment:</u></b></p> <ul style="list-style-type: none"> <li>• Short-answer exercise</li> </ul>
<p>23 August 2022* (Tuesday)</p> <p>9:30 am – 12:30 pm 2:00 pm – 5:00 pm</p>	<p>Make-up Class</p>

<b>Duration</b>	3 day sessions (total 18 contact hours)
<b>Date</b>	15, 17, 19 August 2022 23 August 2022* (make-up class)
<b>Time</b>	9:30 am – 12:30 pm; 2:00 pm – 5:00 pm
<b>Teaching Mode<sup>#</sup></b>	Face to Face (The Chinese University of Hong Kong)
<b>Enrollment</b>	30
<b>Expected Applicants</b>	Students who are studying S1-S3 (in the academic year 2021-2022)
<b>Tuition Fee</b>	HKD 3,180.00
<b>Credit</b>	1.25 Academy Unit Certificates or letters of completion will be awarded to students who attain at least 75% attendance and pass the assessment (if applicable).

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**The Chinese University of Hong Kong  
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Summer Courses 2022  
Course Outline

***CUSA1091 Artistic and Colourful Chemistry***  
色彩斑斕的化學世界

**Introduction:**

This course combines the disciplines of science and culture, and aims to provide students with fundamental understanding on the nature of science and their influences on our culture and daily life.

This course aims to provide students, who have a knowledge of the principles of chemistry, an overview on the mechanism of perceiving colors, the production of various classes of dyes and pigments, including their corresponding applications. Graphics, demonstrations, and project presentations are the major elements of interactive learning environment in this course.

本課程將結合科學與文化的內容，目的讓學生對基礎自然科學有更深入認識和了解，以至科學對日常生活和文化的影響。

本課程冀讓對化學有基拙理解的學生們明白顏色接收的基理，不同類型染料和顏料的製作以及其相應的應用。本課程會以不同的圖片，示範，小組專題研習及報告的形式以達至互動的學習環境和氣氛。

**Medium of Instruction:** Cantonese supplemented with English

**Organising Unit:** Department of Chemistry, Faculty of Science, CUHK

**Teachers:** Dr. Sam Chun Kit HAU  
Department of Chemistry, CUHK  
Rm. G1564, Science Centre South, CUHK,  
Tel: 3943 8135, Email: [sckhau@cuhk.edu.hk](mailto:sckhau@cuhk.edu.hk)



**Course Content:**

<p>23 Jul 2022 (Saturday)</p> <p>9:00 am – 12:00 pm 2:00 pm – 5:00 pm</p>	<p><b><u>Lecture:</u></b> A Brief Historical Introduction on Color The Physical and Chemical Basis of Color</p> <p><b><u>Lab:</u></b> <i>Colour Composition in dyes and ink</i></p> <p><b><u>Assessment:</u></b> In Class Worksheet or Online Google Form</p>
<p>30 Jul 2022 (Saturday)</p> <p>9:00 am – 12:00 pm 2:00 pm – 5:00 pm</p>	<p><b><u>Lecture:</u></b> Azo Dyes and Pigments Carbonyl Dyes and Pigments</p> <p><b><u>Lab:</u></b> <i>Synthesis of Azo Dyes</i></p> <p><b><u>Assessment:</u></b> In Class Worksheet or Online Google Form</p>
<p>6 August 2022 (Saturday)</p> <p>9:00 am – 12:00 pm 2:00 pm – 5:00 pm</p>	<p><b><u>Lecture:</u></b> Textile Dyes Inorganic Pigments Applications of Dyes and Pigments</p> <p><b><u>Lab:</u></b> <i>Dyeing Method with DIY Dyes</i></p> <p><b><u>Assessment:</u></b> In Class Worksheet or Online Google Form</p>
<p>13 August 2022* (Saturday)</p> <p>9:00 am – 12:00 pm 2:00 pm – 5:00 pm</p>	<p>Make-up Class</p>

<b>Duration</b>	3 day sessions (total 18 contact hours)
<b>Date</b>	23, 30 July 2022, 6 August 2022 13 August 2022* (make up class)
<b>Time</b>	9:00 am – 12:00 pm & 2:00 pm – 5:00 pm
<b>Teaching Mode<sup>#</sup></b>	Face to Face (The Chinese University of Hong Kong)
<b>Enrollment</b>	25
<b>Expected Applicants</b>	Students who are promoting or studying S3-S6
<b>Tuition Fee</b>	HKD 3,180.00
<b>Credit</b>	1.25 Academy Unit Certificates or letters of completion will be awarded to students who attain at least 75% attendance.

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Summer Courses 2022  
Course Outline

*SAYT1001 Bondings in Organic Compounds, and  
Reactivity and Selectivity of Organic Reactions*  
有機化合物的鍵合，與有機反應的活性及選擇性

**Introduction:**

This course is designed to allow students to have a basic understanding about the bonding and structures of organic molecules and ions, and their influences on the molecular properties of organic compounds, and the reactivity and selectivity of some organic reactions. This course will focus on the stability of reaction intermediates, and the reactivity and selectivity of addition reactions, nucleophilic substitutions, eliminations, and electrophilic aromatic substitutions.

本課程設計旨在讓同學對有機分子及離子的鍵合及結構，及它們在有機分子的特性和有機反應的活性及選擇性的影響上有基礎的理解。本課程將會集中討論各類反應中間體的穩定性，及加成反應、親核取代反應、消除反應和親電芳香取代反應的活性及選擇性。

**Medium of Instruction:** English supplemented with Cantonese

**Organising Unit:** Department of Chemistry, Faculty of Science, CUHK

**Teachers:** Dr. Mak Kin Wah  
Department of Chemistry, CUHK  
Rm. 355, Science Centre South, CUHK  
Tel: 3943 8136, Email: [kendrewmak@cuhk.edu.hk](mailto:kendrewmak@cuhk.edu.hk)

**Course Content:**

<p>15 August 2022 (Monday)</p> <p>9:30am – 12:30pm 2:00pm – 5:00pm</p>	<p><b><u>Lecture and Activities:</u></b></p> <ul style="list-style-type: none"> <li>• Basic atomic structure, chemical bonding and shape of molecules</li> <li>• Atomic orbitals (s, p, d, f) and electron configurations</li> <li>• Formation of <math>\sigma</math>-bonds and <math>\pi</math>-bonds</li> <li>• Orbital hybridization, bond formation and molecular shapes</li> </ul> <p><b><u>Assessment:</u></b></p> <ul style="list-style-type: none"> <li>• Multiple-choice and short-answer test</li> </ul>
<p>17 August 2022 (Wednesday)</p> <p>9:30am – 12:30pm 2:00pm – 5:00pm</p>	<p><b><u>Lecture and Activities:</u></b></p> <ul style="list-style-type: none"> <li>• Delocalized electrons and resonance</li> <li>• Resonance structures and resonance stabilization</li> <li>• Nomenclature of organic compounds</li> <li>• Reaction of alkanes and alkenes</li> <li>• Reaction mechanism</li> </ul> <p><b><u>Assessment:</u></b></p> <ul style="list-style-type: none"> <li>• Multiple-choice and short-answer test</li> </ul>
<p>19 August 2022 (Friday)</p> <p>9:30am – 12:30pm</p>	<p><b><u>Lecture and Activities:</u></b></p> <ul style="list-style-type: none"> <li>• Nucleophilic substitutions: <math>S_N1</math> and <math>S_N2</math></li> <li>• Elimination reactions: E1 and E2</li> </ul> <p><b><u>Assessment:</u></b></p> <ul style="list-style-type: none"> <li>• Multiple-choice and short-answer test</li> </ul>
<p>23 August 2022* (Tuesday)</p> <p>9:30am – 12:30pm 2:00pm – 5:00pm</p>	<p>Make-up class</p>

<b>Duration</b>	2.5 day sessions (total 15 contact hours)
<b>Date</b>	15, 17, 19 August 2022 23 August 2022* (make up class)
<b>Time</b>	9:30 am – 12:30 pm & 2:00 pm – 5:00 pm
<b>Teaching Mode<sup>#</sup></b>	Face to Face (The Chinese University of Hong Kong)
<b>Enrollment</b>	25
<b>Expected applicants</b>	Students who are promoting to or studying S4-S6
<b>Tuition Fee</b>	HKD 3,000.00
<b>Credit</b>	1 University Unit Certificates or letters of completion will be awarded to students who attain at least 75% attendance.

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Summer Courses 2022  
Course Outline

***CUSA1013 Great Discoveries in Biomedical Sciences***  
**生物醫學大發現**

**Introduction:**

This course is the foundation course of CUSA2013 Great Discoveries of Biochemical Sciences (Senior Class), aiming at providing a holistic review of the development of life sciences. The course shall provide Secondary 1 to 3 students with some general understanding of prehistoric life forms, such as prokaryotic cells to more complex organisms ever existed on Earth, followed by the evolution of human beings. Finally, some milestones of the industrial revolution associated to the highlights of modern biomedical sciences shall be covered. Throughout the study of a series of fundamental topics, students are expected to gain some foundation knowledge of life and its evolution; interested students are encouraged to join the senior class to pursue some more in-depth knowledge related to biomedical sciences.

本課程為 CUSA2013 生化科學大發現(高級班)的基礎課程，旨在讓初中生回顧生命科學的發展。課程內容包括一些史前生物的知識，例如原核細胞和其他在地球曾出現過的生物；從而再為同學介紹人類的演化。最後，本課程更將涵蓋工業革命以來的一些重要里程碑以及現代生物醫學的一些前瞻。通過對一系列特定課題的介紹，同學們將對生命及其演化有更多的理解；此有助鼓勵感興趣的學生再報讀高級班，進而追求生物醫學更深入的科學知識。

**Medium of Instruction:** Cantonese supplemented with English

**Organising Unit:**

Biochemistry Programme, School of Life Sciences, Faculty of Science, CUHK

**Teacher:**

Dr. LO Fai Hang

School of Life Sciences, CUHK

Rm. G83, Science Centre, CUHK

Tel: 3943 5019, E-mail: [lofaihang@cuhk.edu.hk](mailto:lofaihang@cuhk.edu.hk)

**Demonstrators:**

Students from Programme of Biochemistry, School of Life Sciences, CUHK

**Course Content:**

<p>27 August 2022 (Saturday)</p> <p>9:30 am - 1:00 pm</p>	<p><b><u>Lecture:</u></b></p> <ul style="list-style-type: none"> <li>• Introduction to basic biomolecules, such as genetic materials and enzymes</li> <li>• Evolution of life from prokaryotic cells to multicellular organisms</li> <li>• The stories of Homo sapiens</li> <li>• Industrial revolution and the development of life sciences</li> </ul> <p>Next gen biomedical sciences</p> <p><b><u>Other in-class activities</u></b></p>
<p>3 September 2022* (Saturday)</p> <p>9:30 am - 1:00 pm</p>	<p>Make-up class</p>

<b>Duration</b>	1 whole day sessions (total 3.5 contact hours)
<b>Date</b>	27 August 2022 3 September 2022* (make-up class)
<b>Time</b>	9:30 am - 1:00 pm
<b>Venue<sup>#</sup></b>	Face to Face (The Chinese University of Hong Kong)
<b>Enrollment</b>	20 – 25
<b>Expected applicants</b>	S1-S3 Students who are interested in biomedical sciences
<b>Tuition Fee</b>	HKD 800.00 (including materials for activities)
<b>Credit</b>	0.25 Academy Unit Certificate or letter of completion will be awarded to students who attain at least 75% attendance and pass the assessment (if applicable)

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Course Outline

***CUSA1043 Life Science in Daily Life***  
**日常生活中的生命科學**

**Introduction:**

Life science is the study of all living organisms and life processes at all levels from ecological to molecular. While many people refer life science as biology, it is an enormous field of study that also covers genetics, molecular biology, cell biology, biochemistry, food science, biotechnology, ecology, and more. The knowledge of life science teaches us to respect and love the nature and all life forms. It also plays a substantial role in human welfare and helps to create many of our daily needs ranging from food to medicine.

生命科學以科學方式對所有生物體和生命過程由生態到分子各個層面進行研究。雖然許多人將生命科學稱為生物學，但其實它是一個巨大的研究領域，其中還包括遺傳學、分子生物學、細胞生物學、生物化學、食品科學、生物技術、生態學等。生命科學的知識教會我們尊重和熱愛自然和所有生命體。它還在人類福利方面發揮著重要作用，並有助於創造我們從食物到藥品的許多日常需求。

**Medium of Instruction:** Cantonese supplemented with English

**Organising Unit:** School of Life Sciences, Faculty of Science, CUHK

**Teacher:** Professor NGO Chi Ki Jacky  
School of Life Sciences, Faculty of Science, CUHK  
Rm E403, Science Centre East Block, CUHK  
E-mail: [jackyngo@cuhk.edu.hk](mailto:jackyngo@cuhk.edu.hk)

**Course Content:**

<p>2 July 2022 (Saturday)</p> <p>9:00 am – 12:30 pm 2:00 pm – 5:30 pm</p>	<ul style="list-style-type: none"> <li>• What are Life Sciences?</li> <li>• Importance of Life Sciences in Our Daily Lives.</li> <li>• Thinking and Acting like a Life Scientist.</li> </ul>
<p>9 July 2022 (Saturday)</p> <p>9:00 am – 12:30 pm 2:00 pm – 5:30 pm</p>	<ul style="list-style-type: none"> <li>• The Building Blocks of Our Bodies.</li> <li>• DNA – the Blueprint of Life.</li> </ul>
<p>16 July 2022 (Saturday)</p> <p>9:00 am – 12:30 pm 2:00 pm – 5:30 pm</p>	<ul style="list-style-type: none"> <li>• The Central Dogma: From DNA to Proteins.</li> <li>• The 20 Letters of Protein that Make Life Possible.</li> </ul>
<p>23 July 2022 (Saturday)</p> <p>9:00 am – 12:30 pm 2:00 pm – 5:30 pm</p>	<ul style="list-style-type: none"> <li>• Unleashing the Potentials of Life Sciences.</li> </ul>
<p>30 July 2022* (Saturday)</p> <p>9:00 am – 12:30 pm 2:00 pm – 5:30 pm</p>	<p>Make up Class</p>

<b>Duration</b>	4 whole day sessions (total 28 contact hours)
<b>Date</b>	2, 9, 16, 23 July 2022 30 July 2022 *
<b>Time</b>	9:00 am – 12:30 pm; 2:00 pm – 5:30 pm
<b>Teaching Mode<sup>#</sup></b>	Face to Face (The Chinese University of Hong Kong)
<b>Enrollment</b>	20
<b>Expected Applicants</b>	Students who are promoting to or studying S1-S3
<b>Tuition Fee</b>	HKD 3,780.00
<b>Credit</b>	2 Academy Unit Certificate will be issued to students who fulfill the course requirement, i.e. pass in assessment and attain 75% attendance.

\* This date is reserved for make-up classes in case there is any cancellation of classes due to unexpected circumstances.

# This course will be offered on CUHK campus in face-to-face mode. It may switch to online teaching in accordance with the pandemic development and the policy of the university.

**The Chinese University of Hong Kong**  
**Faculty of Science**  
**Science Academy for Young Talent**

Summer Courses 2022  
Course Outline

***CUSA2023 Introduction to Bionics***  
**仿生學淺談**

**Introduction:**

Bionics is the branch of science dedicated to the studying of the characteristics, structure or functions of bio-systems for innovations in developing new technology, it is also known as “Biomimicry” or “Biomimetics”. Since 1960s, bionics has developed quickly and applied widely in various fields of science and technology. With an emphasis on the scientific basis of various processes or phenomena in nature, this course aims to introduce to the students the various inspirations which human beings acquired from nature, the methodology, the major applications, and the advancements of bionics. Students will learn in form of lectures, videos, demonstrations, quizzes, discussions, and also gain hands-on experience through participating in worksheets and self-exploratory activities.

仿生學又稱為「模擬生物學」或「生物模仿學」，是一門研究生物系統的特質、結構及功能原理的科學，主要用以研發各種創新科技。自六十年代開始，仿生學的迅速發展使其在各個科學及技術範疇中漸漸普及。本課程旨在以各種科學現象或過程的原理為基礎，通過講解、視頻、示範、測驗、及討論等內容介紹仿生學的原理及仿生學在各方面的應用。學生亦可通過工作紙及在家實驗等活動，親身了解仿生學的基本原理。

**Medium of Instruction:** Cantonese supplemented with English

**Organising Unit:** Centre for Promoting Science Education, Faculty of Science, CUHK

**Teacher:**

Dr. Chung Kwok Cheong  
School of Life Sciences, CUHK  
Email: [kcchung@cuhk.edu.hk](mailto:kcchung@cuhk.edu.hk)



**Course content:**

13 August 2022 (Saturday)  2:00 pm – 5:00 pm	<p><b><u>Lecture:</u></b></p> <ul style="list-style-type: none"> <li>• Introduction: history, methodology and scope of Bionics</li> </ul> <p><b><u>Demonstration:</u></b></p> <ul style="list-style-type: none"> <li>• Relationship between the number of setae in Gecko foot &amp; its holding force</li> </ul>
16 August 2022 (Tuesday)  2:00 pm – 5:00 pm	<p><b><u>Lecture:</u></b></p> <ul style="list-style-type: none"> <li>• Application of Bionics: structures / materials / architecture</li> </ul> <p><b><u>Demonstration:</u></b></p> <ul style="list-style-type: none"> <li>• Superhydrophobicity, the lotus effect and water striders</li> </ul> <p><b><u>Homework:</u></b></p> <ul style="list-style-type: none"> <li>• How to build stronger bones?</li> </ul>
18 August 2022 (Thursday)  2:00 pm – 5:00 pm	<p><b><u>Lecture:</u></b></p> <ul style="list-style-type: none"> <li>• The secrets of flying: Principle of animal flight &amp; aerodynamics</li> </ul> <p><b><u>Homework:</u></b></p> <ul style="list-style-type: none"> <li>• Practice flying with a Glider/Pterosaur model</li> </ul>
23 August 2022 (Tuesday)  2:00 pm – 5:00 pm	<p><b><u>Lecture:</u></b></p> <ul style="list-style-type: none"> <li>• Use of sound by animals</li> <li>• Application of Bionics: art / energy / management</li> </ul> <p><b><u>Homework:</u></b></p> <ul style="list-style-type: none"> <li>• The folding leaves exercise</li> </ul>
25 August 2022 (Thursday)  2:00 pm – 5:00 pm	<p><b><u>Lecture:</u></b></p> <ul style="list-style-type: none"> <li>• Application of Bionics: health / medicine</li> </ul>
29 August 2022 (Monday)  2:00 pm – 5:00 pm	<p><b><u>Lecture:</u></b></p> <ul style="list-style-type: none"> <li>• Application of Bionics: environmental and sustainability</li> </ul> <p><b><u>Homework:</u></b></p> <ul style="list-style-type: none"> <li>• Find out the golden ratio: Constructing the “Golden Section Gauge”</li> </ul>
31 August 2022* (Wednesday)  2:00 pm – 5:00 pm	Make-up Class

<b>Duration</b>	6 half day sessions (total 18 contact hours)
<b>Date</b>	13, 16,18, 23, 25, 29, 31* August 2022
<b>Time</b>	2:00 pm – 5:00 pm
<b>Teaching Mode<sup>#</sup></b>	Face to Face (The Chinese University of Hong Kong)
<b>Enrollment</b>	40
<b>Expected applicants</b>	Students who are promoting to or studying S2-S3
<b>Tuition Fee</b>	HKD 3,180.00
<b>Credit</b>	1.25 Academy Unit Certificates or letters of completion will be awarded to students who attain at least 75% attendance and awarded B grade or above in the course.

\* This date is reserved for make-up classes in case there is any cancellation of classes due to unexpected circumstances.

# This course will be offered on CUHK campus in face-to-face mode. It may switch to online teaching in accordance with the pandemic development and the policy of the university.

**The Chinese University of Hong Kong  
Faculty of Science  
Science Academy for Young Talent**

Summer Courses 2022  
Course Outline

***CUSA2043 An Ocean of Inspiration and Beauty***  
**海洋啟示錄**

**Introduction:**

The oceans cover 70% of the Earth's surface and is the biggest biome on Earth as well as the most important component of the biosphere. Being the cradle of life on Earth, the ocean is also the crucial factor for maintaining life on Earth. In the history of mankind, the oceans have been admired and greatly respected for its significance in the exploration of nature, as well as in the development of human civilization. This course intends to offer an overview of the oceans from perspectives such as culture, history, science, philosophy and arts; as well as to acknowledge the importance of the oceans to mankind and other life forms on Earth. The core concepts include the roles played by the oceans in the development of human civilization, the impact and reliance of human beings on the oceans, ocean processes and the physical, chemical and biological properties of the oceans, diversity of marine ecosystems and marine organisms, how marine organisms solve their specific problems and provide inspirations for solving human problems, the importance of the oceans in maintaining global climatic and ecological balances, as well as how we should protect, conserve and sustainably exploit the oceans for our future generations and all life forms on Earth.

海洋覆蓋了地球七成的表面，是地球最大的生物群系和生物圈最重要的部份。海洋既是地球上生命產生的搖籃，又是維持生命的必要關鍵因素。自古以來人類對神祕莫測的海洋既敬畏又嚮往；海洋是人類對自然的探索 以至文明的產生和發展過程中極重要部份。本課程旨在讓學員從文化、歷史、科學、哲學、及藝術等角度去認識海洋；及了解海洋對人類以至其他生物的重要性。主要課程內容包括海洋在人類文明發展的角色、人類對海洋的影響和依賴、各種海洋過程及海洋的物理，化學，生物等方面的特性、海洋生態系和海洋生物的多樣性、海洋生物如何適應獨海洋環境並為人類提供解決問題的靈感、海洋在調節全球氣候和生態平衡的功能、及我們應如何維護、保育及永續地開發海洋等。

**Medium of Instruction:** Cantonese supplemented with English

**Organising Unit:**

Centre for Promoting Science Education,  
Faculty of Science,  
The Chinese University of Hong Kong

**Teacher:**

Dr. Chung Kwok Cheong  
School of Life Sciences, CUHK  
Email: [kcchung@cuhk.edu.hk](mailto:kcchung@cuhk.edu.hk)

**Course Content:**

2 July 2022 (Saturday)  9:30 am – 1:00 pm	<b><u>Theme 1. Ocean and Man:</u></b> 1. The oceans and the marine environment; 2. Importance of the oceans; 3. A history of maritime development; 4. The rise and fall of maritime power.
9 July 2022 (Saturday)  9:30 am – 1:00 pm	<b><u>Theme 1. Ocean and Man:</u></b> 1. Marine resources and their exploitation; 2. Deterioration & conservation of the marine environment.
16 July 2022 (Saturday)  9:30 am – 1:00 pm	Theme 2. Marine Ecosystems: 1. The marine environment, zonation of the oceans, physical and chemical properties; 2. Plate tectonics & associated phenomena; 3. Ocean processes.
23 July 2022 (Saturday)  9:30 am – 1:00 pm	Theme 2. Marine Ecosystems: 1. Coastal marine ecosystems: rocky shores, mangrove forests, estuary / soft-bottom intertidal ecosystems, coral reefs, kelp forests etc. 2. Oceanic marine ecosystems: open oceans and deep oceans, hydrothermal vents and cold seeps etc.
30 July 2022 (Saturday)  9:30 am – 1:00 pm	Theme 3. Marine Organisms: 1. Classification of living organisms; 2. Major types of marine organisms.
6 August 2022 (Saturday)  9:30 am – 1:00 pm	Theme 3. Marine Organisms: 1. Survival, adaptation & evolution of marine organisms; 2. Inspirations from marine organisms.
13 August 2022 * (Saturday)  9:30 am – 1:00 pm	Make-up Class

<b>Duration</b>	6 half-day sessions (total 21 contact hours)
<b>Date</b>	2, 9, 16, 23,30 July, 6, 13* August 2022
<b>Time</b>	9:30 am – 1:00 pm
<b>Teaching Mode<sup>#</sup></b>	Face to Face (The Chinese University of Hong Kong)
<b>Enrollment</b>	40
<b>Expected applicants</b>	Students who are promoting to or studying S4-S6
<b>Tuition Fee</b>	HKD 3,360.00
<b>Credit</b>	1.5 Academy Unit Certificates or letters of completion will be awarded to students who attain at least 75% attendance and awarded B grade or above in the course.

\* This date is reserved for make-up classes in case there is any cancellation of classes due to unexpected circumstances.

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The Chinese University of Hong Kong  
Faculty of Science  
Science Academy for Young Talent

Summer Courses 2022  
Course Outline

*CUSA1035 Mysteries in the Atomic World*  
*原子世界的奧秘*

**Introduction:**

This course will bring students to retrace the thinking paths of physicists in the early 20th century to unravel the mysteries of atoms. The course includes lectures, experiments, and a visit. Students will glimpse through the basic concepts of quantum physics, such as wave particle duality, quantization, wave function and its probabilistic interpretation, spin, and their applications to understand some atomic and nuclear phenomena, including energy levels in atoms, atomic spectra, formation of molecules, as well as a more advanced topic on magnetic resonance imaging (MRI), which is now widely applied to medical imaging.

Students will gain hands-on experience in using modern laboratory equipment to measure atomic spectra, and determine the charge mass ratio of electron. A visit to a company in Hong Kong Science and Technology Park will also be included to let students gain hands-on experience on the operation of a medical MRI machine.

本課程帶領學生重溫二十世紀初物理學家探索原子奧秘的過程。課程包括講座、實驗，和參觀三部分。學生將瞥見量子物理的基本概念，包括波粒二象性、量子化、波函數及其或然率詮釋，自旋；這些概念如何應用於了解原子和核子的現象，包括原子的能階、光譜、分子的形成，以及一個較深入、目前廣泛應用於醫療造影的現象：磁力共振。

學生也會學習如何利用現代科學儀器測量原子的光譜，以及電子的電荷質量比。課程也包括到香港科學技術園參觀一間儀器公司，以體驗實際操作醫學磁力共振儀器。

**Medium of Instruction:** Cantonese supplemented with English

**Organising Unit:**

Department of Physics, Faculty of Science, CUHK

**Teacher:**

Dr. TONG Shiu Sing

Department of Physics, Faculty of Science, CUHK

Rm. 223, 2/F, Science Centre North Block, CUHK

Tel: 3943 6400, E-mail: [sstong@phy.cuhk.edu.hk](mailto:sstong@phy.cuhk.edu.hk)

**Course Content:**

<p>25 August 2022 (Thursday)</p> <p>9:00 am – 12:30 pm 2:00 pm – 5:30 pm</p>	<p><b><u>Lecture and demos:</u></b> Discovery of subatomic particles, atomic spectra, wave particle duality, relationship between classical wave phenomena and quantization, atomic models and quantization of atomic energy, and the emergence of quantum physics</p> <p><b><u>Laboratory Activities:</u></b></p> <ul style="list-style-type: none"> <li>• Study of atomic spectra, and charge to mass ratio of electron</li> </ul>
<p>26 August 2022 (Friday)</p> <p>9:00 am – 12:30 pm 2:00 pm – 5:30 pm</p>	<p><b><u>Lecture and demos:</u></b> Basic concepts of quantum physics, conceptual understanding of Schrodinger equation, wave function and probabilistic interpretation. Electron microscope, quantum phenomena such as quantum tunnelling and our existence.</p> <p><b><u>Laboratory Activities:</u></b></p> <ul style="list-style-type: none"> <li>• Visiting the modern physics laboratory at the Department of Physics, CUHK. Experiments with a scanning electron microscope and a transmission electron microscope, seeing microscopic objects, atoms, and electron diffraction patterns</li> </ul>
<p>27 August 2022 (Saturday)</p> <p>9:00 am – 12:30 pm 2:00 pm – 5:30 pm</p>	<p><b><u>Visit:</u></b> Visiting a Magnetic Resonance Imaging (MRI) company at Hong Kong Science Park. Experience the operation of a MRI machine and acquisition of MRI images.</p> <p><b><u>Lecture and demos:</u></b> Introduction to the concepts of spin, Pauli Exclusion Principle and atomic orbitals, and their applications to understand some atomic and nuclear phenomena including MRI.</p> <p><b><u>Discussion:</u></b></p> <ul style="list-style-type: none"> <li>• Summary of essential ideas and findings, assessment</li> </ul>
<p>29 August 2022* (Monday)</p> <p>9:00 am – 12:30 pm 2:00 pm – 5:30 pm</p>	<p>Make up Class</p>

<b>Duration</b>	3 whole day sessions (total 21 contact hours)
<b>Date</b>	25, 26, 27 August 2022 29 August 2022 *
<b>Time</b>	9:00 am – 12:30 pm; 2:00 pm – 5:30 pm
<b>Teaching Mode<sup>#</sup></b>	Face to Face (The Chinese University of Hong Kong)
<b>Enrollment</b>	30
<b>Expected Applicants</b>	Students who are promoting to or studying S4-S6 who have basic knowledge on mechanics and waves
<b>Tuition Fee</b>	HKD 3,560.00 (including materials for experiments)
<b>Credit</b>	1.5 Academy Unit Certificates or letters of completion will be awarded to students who attain at least 75% attendance.

\* This date is reserved for make-up classes in case there is any cancellation of classes due to unexpected circumstances.

# This course will be offered on CUHK campus in face-to-face mode only. It may be cancelled in accordance with the pandemic development and the policy of the university.

The Chinese University of Hong Kong  
Faculty of Science  
Science Academy for Young Talent

Summer Courses 2022  
Course Outline

*CUSA1085 The Space Explorer's Survival Guide to the Universe*  
*太空探索者的宇宙生存指南*

**Introduction:**

The universe is a dangerous place for us space explorers. To give you a fighting chance to survive the journey, we will discuss some basic mechanics, the law of gravity, astronomy, and other necessary physics. More importantly, since the laws of the universe are written in the language of mathematics, we need to go through some basic calculus (don't be afraid, my friend) and elementary differential equations (now you can panic a little bit). We will also introduce you with the concept of scientific modelling, and learn to use computer to numerically solve problems (we will not use HAL 9000, for those of you who are worried). By the end of our course, you will be well equipped to apply the new tools to tackle a wide range of problems.

Some of you probably have never learned calculus before. While it could be intimidating at first, you can still do it if you put in effort. Some hands-on examples in our course should get you up to speed.

Now buckle up, and we will get started!

對我們這些太空探索者來說，宇宙是一個很危險的地方。為求讓你有能力完成旅程，我們會討論一些基本的力學、重力定律、天文學和其他必要的物理原理。更重要的是，宇宙的定律是用數學語言寫成的，因此我們需要進行學習一些基本的微積分（請不要太擔心……）和簡單的微分方程（你現可以有些少許恐慌了）。我們亦將會介紹科學建模的概念，並學習使用電腦來解決問題（放心，我們不會使用 HAL 9000）。在課程結束時，你將會有能力應用這些新的工具來處理各種問題。

你們當中有些人可能從未學過微積分。這課題在初學時可能真的嚇人的，但只要你付出努力，仍然可以學到。而且在課程中的實際操作示例應該能使你快速上手。

好！現在就扣好安全帶，讓我們開始！

**Medium of Instruction:** Cantonese supplemented with English

**Organising Unit:**

Department of Physics, Faculty of Science, CUHK

**Teacher:**

Dr. LEUNG Po Kin

Department of Physics, CUHK

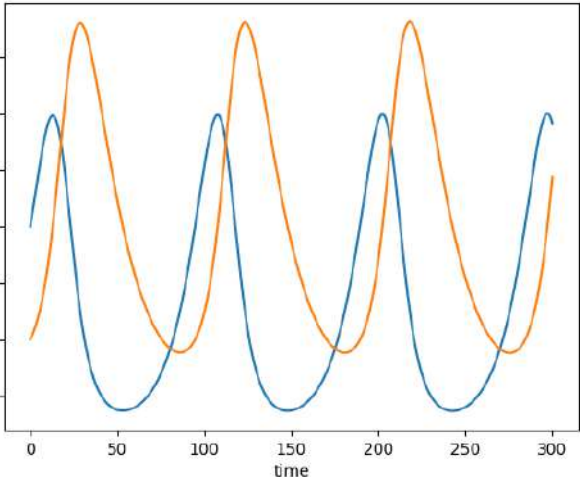
Rm. 220, Science Centre North Block, CUHK

Tel: 3943 4078, E-mail: [pkleung@cuhk.edu.hk](mailto:pkleung@cuhk.edu.hk)

**Demonstrators:**

Students from Department of Physics, CUHK

**Course Content:**

<p>15 August 2022 (Monday)</p> <p>2:00 pm – 5:00 pm</p>	<p><b>Lecture 講課: (3 hrs)</b></p> <ul style="list-style-type: none"><li>• Dimensional analysis 量綱分析</li><li>• Newton's laws of motion 牛頓運動定律</li><li>• Linear momentum 動量</li></ul> <p><b>Assessment 評核:</b></p> <p>Homework (short questions) 功課 (短題目)</p>
<p>16 August 2022 (Tuesday)</p> <p>2:00 pm – 5:00 pm</p>	<p><b>Lecture 講課: (3 hrs)</b></p> <ul style="list-style-type: none"><li>• Basics of calculus 微積分入門</li><li>• Simple differential equations (i.e. rate equations) 簡單微分方程 (即改變率方程)</li></ul> <p><b>Assessment 評核:</b></p> <p>Homework (short questions) 功課 (短題目)</p>
<p>17 August 2022 (Wednesday)</p> <p>2:00 pm – 5:00 pm</p>	<p><b>Lecture 講課: (3 hrs)</b></p> <ul style="list-style-type: none"><li>• Solving differential equations with computer 以電腦解微分方程</li><li>• Basics of scientific modelling 科學建模入門 (e.g. radioactivity, examples in mechanics 例：放射性、力學的例子)</li></ul> <p><b>Assessment 評核:</b></p> <ul style="list-style-type: none"><li>• Homework (short questions) 功課 (短題目)</li></ul>
<p>18 August 2022 (Thursday)</p> <p>2:00 pm – 5:00 pm</p>	<p><b>Lecture 講課: (3 hrs)</b></p> <ul style="list-style-type: none"><li>• Air drag force 空氣阻力</li><li>• Force of spring 彈簧力</li><li>• More examples of solving differential equations with computer 更多以電腦解微分方程的例子</li></ul> <p><b>Assessment 評核:</b></p> <ul style="list-style-type: none"><li>• Homework (short questions) 功課 (短題目)</li></ul>
<p>19 August 2022 (Friday)</p> <p>2:00 pm – 5:00 pm</p>	<p><b>Lecture 講課: (3 hrs)</b></p> <ul style="list-style-type: none"><li>• Scientific modelling, revisited 科學建模, 再探 (e.g. the interplay of prey and predator 例：獵物和捕食者的互動)</li><li>• More examples of solving differential equations with computer 更多以電腦解微分方程的例子</li></ul> <p style="text-align: center;">Populations of rabbit (blue) and wolf (x100, orange)</p>  <p><b>Assessment 評核:</b></p> <ul style="list-style-type: none"><li>• Homework (short questions) 功課 (短題目)</li></ul>

22 August 2022 (Monday)  2:00 pm – 5:00 pm	<p><b>Lecture 講課: (3 hrs)</b></p> <ul style="list-style-type: none"> <li>Kepler's law of planetary motion 開普勒行星運動定律</li> <li>Newton's law of universal gravitation 牛頓萬有引力定律</li> </ul> <p><b>Assessment 評核:</b></p> <ul style="list-style-type: none"> <li>Homework (short questions) 功課 (短題目)</li> </ul>
23 August 2022 (Tuesday)  2:00 pm – 5:00 pm	<p><b>Lecture 講課: (2 hrs)</b></p> <ul style="list-style-type: none"> <li>Calculating the trajectory of planets with computer 以電腦計算行星軌跡</li> <li>If possible, will arrange a remote meeting of researchers from the HK Observatory, to learn about the application of computer simulations 會嘗試安排和天文台的研究員遙距會面，了解電腦模擬的應用 (Otherwise, more examples or other advanced topics 如果未能安排遙距會面，更多例子或進階題目)</li> </ul> <p><b>Assessment 評核 (1 hr):</b></p> <ul style="list-style-type: none"> <li>Final test 測驗</li> </ul>
24 August 2022* (Wednesday)  2:00 pm – 5:00 pm	<p>Make-up class 補課</p>

<b>Duration</b>	7 half-day sessions (total 21 contact hours)
<b>Date</b>	15 – 19, 22 – 23 August 2022, 24 August 2022* (make-up class)
<b>Time</b>	2:00 pm – 5:00 pm
<b>Teaching Mode<sup>#</sup></b>	Face to Face (The Chinese University of Hong Kong)
<b>Enrollment</b>	20
<b>Expected Applicants</b>	Students who are promoting to or studying S4-S6
<b>Tuition Fee</b>	HKD 3,360.00
<b>Credit</b>	1.5 Academy Unit Certificates or letters of completion will be awarded to students who attain at least 75% attendance.

\* This date is reserved for make-up classes in case there is any cancellation of classes due to unexpected circumstances.

# This course will be offered on CUHK campus in face-to-face mode. It may switch to online teaching in accordance with the pandemic development and the policy of the university.



The Chinese University of Hong Kong  
Faculty of Science  
Science Academy for Young Talent

Summer Courses 2022  
Course Outline

*SAYT1016 Data Science: Inference, Prediction and Learning*  
*數據科學：推理、預測和學習*

**Introduction:**

Uncertainty exists in many real-life problems, ranging from stock returns to sport results to medication effects to election outcomes. Statistics offers methods to handle uncertainty with a higher precision. This course introduces ways to define, model and forecast uncertainty through real-life examples and counterintuitive phenomena. Topics include exchange paradox, Simpson's paradox, linear regression model, non-parametric regression model, historical simulation, and k-mean clustering.

不確定性存在於許多現實生活中的問題，例子涵蓋股票回報、運動結果、藥物效果、選舉結果等。統計科學提供了具更高準定性的方法，以處理不確定性的問題。本課程以實際示例和違反直覺的現象引導，來定義、模型和預測不確定性。主題包括替換悖論，辛普森悖論，線性迴歸模型，非參數迴歸模型，歷史模擬法，k 平均演算法。

**Medium of Instruction:** Cantonese supplemented with English

**Organising Unit:**

Department of Statistics, CUHK

**Teacher:**

Prof. CHAN Kin Wai

Department of Statistics, CUHK

Room 115, Lady Shaw Building, CUHK

E-mail: [kinwaichan@sta.cuhk.edu.hk](mailto:kinwaichan@sta.cuhk.edu.hk)

**Course Content:**

17 August 2022 (Wednesday)  09:30am - 12:30pm 02:30pm - 05:30pm	AM: (Topic 1.1) Exchange paradox: the roles of random variables (Topic 1.2) Simpson paradox: the power of conditional statements  PM: Laboratory section: Introduction of statistical programming language
18 August 2022 (Thursday)  09:30am - 12:30pm 02:30pm - 05:30pm	AM: (Topic 2.1) Linear regression model: borrowing knowledge from covariates  PM: Laboratory section and discussion
19 August 2022 (Friday)  09:30am - 12:30pm 02:30pm - 05:30pm	AM: (Topic 2.2) Nonparametric regression model: learning complex structure  PM: Laboratory section and presentation
22 August 2022 (Monday)  09:30am - 12:30pm 02:30pm - 05:30pm	AM: (Topic 3.1) Historical simulation: fully utilizing data by resampling  PM: Laboratory section and discussion
23 August 2020 (Tuesday)  09:30am - 12:30pm 02:30pm - 05:30pm	AM: (Topic 3.2) k-mean clustering: unsupervised learning  PM: Laboratory section and presentation
24 August 2022* (Wednesday)  09:30am - 12:30pm 02:30pm - 05:30pm	Make-up class

<b>Duration</b>	5 whole day sessions (total 30 contact hours)
<b>Date</b>	17,18,19,22,23 August 2022 24 August 2022* (make-up class)
<b>Time</b>	9:30am-12:30pm & 2:30pm-5:30pm
<b>Teaching Mode<sup>#</sup></b>	Face to Face (The Chinese University of Hong Kong)
<b>Enrollment</b>	50
<b>Expected applicants</b>	Students who are promoting to S4-S5 with good knowledge in mathematics and with strong interest in solving real problems
<b>Tuition Fee</b>	HKD 3,900.00 (Students who have attended all sessions will be granted a HKD 1,000 scholarship)
<b>Credit</b>	1 University Unit Certificates or letters of completion will be awarded to students who attain at least 75% attendance.

\* This date is reserved for make-up classes in case there is any cancellation of classes due to unexpected circumstances.

# This course will be offered on CUHK campus in face-to-face mode. It may switch to online teaching in accordance with the pandemic development and the policy of the university.

The Chinese University of Hong Kong  
Faculty of Science  
Science Academy for Young Talent

Summer Courses 2022  
Course Outline

*CUSA1026 Statistical Modeling and Big Data Analytics*  
*統計模型及大數據分析*

**Introduction:**

Data from various fields, such as climatology, finance and sports, exhibit different properties. This course aims to use the R-package (a statistical software) to visualize the properties of the data, fit the data into various statistical models, evaluate model performance and perform model predictions. Topics include exploratory data analysis, time series models, hidden Markov models, Poisson process and analysis of big data problems. Students will gain hands-on experience in statistical programming at the computer lab.

各種領域的數據（如氣候學，金融及運動）會展示不同的特質。本課程目標是透過統計軟件 R 去透視數據多方面的特性，從而用適當的統計模型去解釋，評估模型的表現及作出數據預測。本課程涵蓋範圍包括：探索性數據分析，時間序列模型，隱馬爾可夫模型，泊松過程和大數據問題的分析。學生將親身體驗統計程式的編寫。

**Learning Outcomes:**

Upon completion of this course, students should be able to:

- 1) Understand data from various fields
- 2) Apply the exploratory data analysis (EDA) to visualize the properties of the data;
- 3) Understand the theories behind various statistical models, and how the models can be fitted into different data sets;
- 4) Write computer programs in R to perform various statistical analysis;
- 5) Develop a systematic approach in solving statistical problems;

**Medium of Instruction:** Cantonese supplemented with English

**Organising Unit:**

Department of Statistics, CUHK

**Teacher:**

Dr. LEE Pak Kuen Philip

Department of Statistics, CUHK

Room 116, Lady Shaw Building, CUHK

E-mail: [pklee@sta.cuhk.edu.hk](mailto:pklee@sta.cuhk.edu.hk)

**Course Content:**

<p>16 July 2022 (Saturday)</p> <p>9:30am– 1:00pm 2:00pm–5:30pm</p>	<p><u>Lecture:</u></p> <ul style="list-style-type: none"> <li>• Basics in Statistical Modeling: Random Variables, Probability Distributions</li> <li>• Sports Data: Properties, Poisson Process, Implied Probability and Odds</li> <li>• Exploratory Data Analysis (EDA): Scatter plot, Box plot, Histogram, Quartile-quartile Plot, Correlation and Autocorrelation</li> </ul> <p><u>Computer Lab Activities:</u></p> <ul style="list-style-type: none"> <li>• R programming: The Basics, Sports Data Modeling, EDA,</li> </ul> <p><u>Assessment:</u></p> <ul style="list-style-type: none"> <li>• Data Modeling in R</li> </ul>
<p>23 July 2022 (Saturday)</p> <p>9:30am– 1:00pm 2:00pm–5:30pm</p>	<p><u>Lecture:</u></p> <ul style="list-style-type: none"> <li>• Climate Data: Properties, Seasonal ARIMA Model, Model Prediction</li> <li>• Financial Data: Properties, Hidden Markov Model, GARCH Model</li> <li>• Monte Carlo Simulation</li> <li>• Big Data Problems and Analysis</li> </ul> <p><u>Computer Lab Activities:</u></p> <ul style="list-style-type: none"> <li>• R programming: Estimation of Time Series Models,</li> </ul> <p><u>Case Discussion and Assessment:</u></p> <ul style="list-style-type: none"> <li>• Data Modeling in R</li> </ul>
<p>30 July 2022* (Saturday)</p> <p>9:30am– 1:00pm 2:00pm–5:30pm</p>	<p><u>Make up class</u></p>

<b>Duration</b>	2 whole day sessions (total 14 contact hours)
<b>Date</b>	16, 23 July 2022 30 July 2022* (make-up class)
<b>Time</b>	09:30am– 1:00pm; 2:00pm–5:30pm
<b>Teaching Mode<sup>#</sup></b>	Online (Zoom)
<b>Enrollment</b>	30
<b>Expected Applicants</b>	Students who are studying S4-S5 with good knowledge in mathematics
<b>Tuition Fee</b>	HKD 2,940.00
<b>Credit</b>	1 Academic Unit Certificates or letters of completion will be awarded to students who attain at least 75% attendance.

\* This date is reserved for make-up classes in case there is any cancellation of classes due to unexpected circumstances.

# This course will be offered online lessons via zoom platform.

**The Chinese University of Hong Kong  
Faculty of Science  
Science Academy for Young Talent**

Summer Courses 2022  
Course Outline

***CUSA1007 Climate Physics and Chemistry***  
**氣候物理與化學**

**Introduction:**

This course presents an integrated scientific introduction to our climate system, focusing on the physics and chemistry of the atmosphere and ocean. The course applies basic scientific and mathematical principles to explain the history, current state and future projections of weather and climate, natural hazards, human-induced climate change, as well as their impacts on natural ecosystems and human society. Students will learn to build a simple climate model using computer software.

本課程綜合介紹我們的氣候系統，重點討論大氣層與海洋的物理和化學。課程利用基本科學和數學原理來解釋天氣及氣候的歷史、現狀和未來預測，探討在人為影響下所構成的自然災害及全球氣候變化，及其對自然生態和人類社會的影響。學生亦會運用電腦程式來學習建構簡單的氣候模型。

**Medium of Instruction:** English supplemented with Cantonese

**Organising Unit:** Earth System Science Programme  
Faculty of Science, The Chinese University of Hong Kong

**Teacher:** Professor Amos P. K. TAI  
Earth System Science Programme, CUHK  
Rm. 316, Mong Man Wai Building, CUHK  
Tel: 3943 9687, E-mail: [amostai@cuhk.edu.hk](mailto:amostai@cuhk.edu.hk)

Dr. LI Kwan Kit Ronald  
Earth System Science Programme, CUHK  
Rm. 340, Science Centre, CUHK  
Tel: 3943 9324, E-mail: [kkarli@cuhk.edu.hk](mailto:kkarli@cuhk.edu.hk)

## Course Content:

<p>25 August 2022 (Thursday)</p> <p>9:30 am – 12:30 pm 2:00 pm – 4:00 pm</p>	<p><b><u>Lecture:</u></b></p> <ul style="list-style-type: none"> <li>• Basic physics of energy and radiation</li> <li>• Earth’s energy balance model</li> <li>• Greenhouse effect</li> </ul> <p><b><u>Laboratory Activities:</u></b></p> <ul style="list-style-type: none"> <li>• Simple climate model</li> </ul> <p><b><u>Assessment:</u></b></p> <p>Exercises from the lab</p>
<p>26 August 2022 (Friday)</p> <p>9:30 am – 12:30 pm 2:00 pm – 4:00 pm</p>	<p><b><u>Lecture:</u></b></p> <ul style="list-style-type: none"> <li>• Climate feedback mechanisms</li> <li>• Basic physics of the atmosphere and oceans</li> <li>• General atmospheric and ocean circulation</li> </ul> <p><b><u>Laboratory Activities:</u></b></p> <ul style="list-style-type: none"> <li>• Climate feedbacks in the simple climate model</li> </ul> <p><b><u>Assessment:</u></b></p> <p>Exercises from the lab</p>
<p>27 August 2022 (Saturday)</p> <p>9:30 am – 12:30 pm 2:00 pm – 4:00 pm</p>	<p><b><u>Lecture:</u></b></p> <ul style="list-style-type: none"> <li>• Biogeochemical cycles</li> <li>• Marine chemistry and carbon cycle</li> <li>• Future climate change: observations and predictions</li> </ul> <p><b><u>Laboratory Activities:</u></b></p> <ul style="list-style-type: none"> <li>• Student presentations on climate change adaptation and mitigation</li> </ul> <p><b><u>Assessment:</u></b></p> <p>Exercises from the lab and presentations</p>
<p>28 August 2022 * (Sunday)</p> <p>9:30 am – 12:30 pm 2:00 pm – 4:00 pm</p>	<p>Make-up class</p>

<b>Duration</b>	3 whole day sessions (total 15 contact hours)
<b>Date</b>	25 – 27 August 2022 28 August 2022* (make-up class)
<b>Time</b>	9:30 am – 12:30 pm; 2:00 pm – 4:00 pm
<b>Teaching Mode<sup>#</sup></b>	Face to Face (The Chinese University of Hong Kong)
<b>Enrollment</b>	20
<b>Expected Applicants</b>	Students who are studying S4-S6 (with background in physics, chemistry or mathematics)
<b>Tuition Fee</b>	HKD 3,000.00
<b>Credit</b>	1 Academy Unit Certificates or letters of completion will be awarded to students who attain at least 75% attendance.

\* This date is reserved for make-up classes in case there is any cancellation of classes due to unexpected circumstances.

# This course will be offered on CUHK campus in face-to-face mode. It may switch to online teaching in accordance with the pandemic development and the policy of the university.