

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

Summer Courses 2021
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

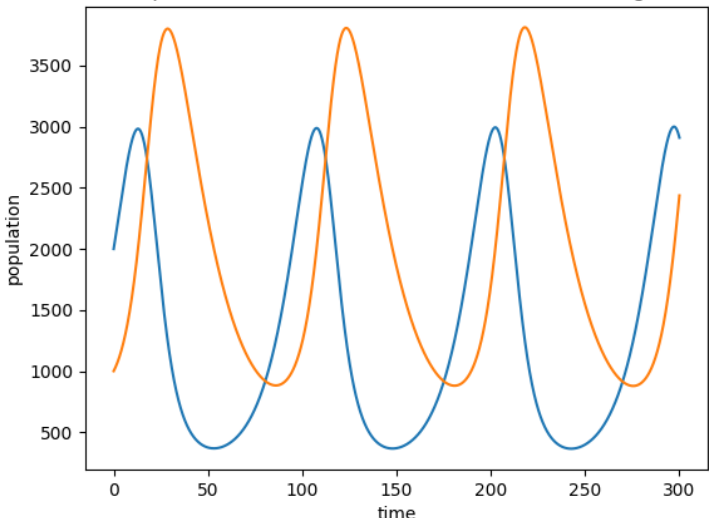
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Demonstrators:

Students from Department of Physics, CUHK

Course Content:

<p>19 July 2021 (Monday)</p> <p>1:00 pm – 5:00 pm</p>	<p><u>Lecture 講課: (4 hrs)</u></p> <ul style="list-style-type: none">• Dimensional analysis 量綱分析• Newton's laws of motion 牛頓運動定律• Linear momentum 動量• Basics of calculus, I 微積分入門, I <p><u>Assessment 評核:</u></p> <ul style="list-style-type: none">• Homework (short questions) 功課 (短題目)
<p>20 July 2021 (Tuesday)</p> <p>1:00 pm – 5:00 pm</p>	<p><u>Lecture 講課: (4 hrs)</u></p> <ul style="list-style-type: none">• Basics of calculus, II 微積分入門, II• 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)• Simple differential equations (i.e. rate equations) 簡單微分方程 (即改變率方程) <p><u>Assessment 評核:</u></p> <ul style="list-style-type: none">• Homework (short questions) 功課 (短題目)
<p>21 July 2021 (Wednesday)</p> <p>1:00 pm – 5:00 pm</p>	<p><u>Lecture 講課: (4 hrs)</u></p> <ul style="list-style-type: none">• Kepler's law of planetary motion 開普勒行星運動定律• Newton's law of universal gravitation 牛頓萬有引力定律• Scientific modelling, revisited 科學建模, 再探 (e.g. the interplay of prey and predator, motion of planets 例：獵物和捕食者的互動、行星運動)• Solving differential equations with computer 以電腦解微分方程 <p style="text-align: center;">Populations of rabbit (blue) and wolf (x100, orange)</p>  <p><u>Assessment 評核:</u></p> <ul style="list-style-type: none">• Homework (short questions) 功課 (短題目)

<p>22 July 2021 (Thursday)</p> <p>1:00 pm – 5:00 pm</p>	<p><u>Lecture 講課: (4 hrs)</u></p> <ul style="list-style-type: none"> • Air drag force 空氣阻力 • Force of spring 彈簧力 • More examples of solving differential equations with computer 更多以電腦解微分方程的例子 <p><u>Assessment 評核:</u></p> <ul style="list-style-type: none"> • Homework (short questions) 功課 (短題目)
<p>23 July 2021 (Friday)</p> <p>1:00 pm – 6:00 pm</p>	<p><u>Lecture 講課: (4 hrs)</u></p> <ul style="list-style-type: none"> • Oscillation 振動 • More examples of solving differential equations with computer 更多以電腦解微分方程的例子 • 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 <p><u>Final test 測驗: (1 hr)</u></p> <p><u>Assessment 評核:</u></p> <ul style="list-style-type: none"> • Final test 測驗
<p>24 July 2021* (Saturday)</p> <p>9:00 am – 1:00 pm</p>	<p>Make-up class 補課</p>

Duration	5 half-day sessions (total 21 contact hours)
Date	19 – 23 July 2021, 24 July 2021* (make-up class)
Time	19 – 22 July 2021: 1:00 pm – 5:00 pm 23 July 2021: 1:00 pm – 6:00 pm
Teaching Mode[#]	Face to Face (The Chinese University of Hong Kong)
Enrollment	20
Expected Applicants	Students who are promoting to or studying S4-S6
Tuition Fee	HKD 3,560.00
Credit	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 is offered face-to-face lessons at CUHK campus. It may switch to online teaching in accordance with the pandemic development and the policy of the university.