國立中正大學通識教育課程教學大綱

National Chung Cheng University Course Syllabus of General Education

開課學年度/學期 School Year/ Semester	114 學年度第 2 學期		
課程名稱 (中文) Course Title (CH)	生命科學中的機制論		
課程名稱 (英文) Course Title (EN)	The Philosophy of Mechanisms in Life Sciences		
課　　碼 Course ID		學分數 Credit	2
授 課 方 式 Instructional Methods	請勾選(可複選) (Multiple Selection)： ■課堂講授 Lecturing　□網路教學 Distant Learning　■分組討論 Group Discussion □校外教學 Fieldtrip　■其他 案例分析 Others Case Study		
教學目標及範圍 Course Objectives	教學目標： 1.透過哲學方法探討生命科學的認識論基礎 2. 經由探索現代科學中的哲學成分，培養人文思維 3. 增進對於科技與人文交織關係的理解 4. 經由認識「機制論」當中可跨領域與跨文化交流的概念，發展多元文化涵養		

	Objectives: By the end of the course, students should be ale to 1. explore the epistemological basis of life sciences by learning philosophical analytical skills 2. develop thinking skills on humanities topics by exploring the philosophical elements of modern sciences 3. appreciate the interactions between and intertwinement of science and humanities 4. develop literacy in inter-cultural and interdisciplinary thinking by learning relevant ideas extracted from the New Mechanical Philosophy 教學範圍： 本課程以生命科學哲學中的「新機制哲學」為核心，新機制哲學是本世紀初的新興科哲領域，背景除了古典的機制論，亦包括二十世紀工程思維在各基礎科學例如生物學中的體現，探討生物學家如何以「機制論」理解自然。本課程旨在啟發學生從哲學角度思考科學解釋與科學實作，並延伸探討其他學科（如物理學、社會科學、工程學）對機制概念的運用，以比較不同領域中「機制論」的共通性與差異性。此一跨學科視野有助學生理解生命科學研究在知識建構上與其他科學的連結，也藉由討論體會更多術語和概念的跨域使用狀況，深化對「生命機制」的哲學理解。 Course scope: The course aims to inspire students to philosophically examine scientific explanation and scientific practice. It provides a general introduction to the New Mechanical Philosophy, which is a field within the philosophy of science. Early mechanical philosophical thoughts had not only been one of the origins of modern sciences but also enormously in-fluenced modern sciences in both theoretical and practical senses. Then, the twentieth

century has witnessed the emergence of engineering-mindedness in various sciences such as biology. Alongside this historical trend, scientists across various disciplines such as biology increasingly understand natural phenomena by searching for responsible mechanisms. The New mechanical Philosophy studies this contemporary mindset and the practices of mechanistic research.

The course further explores uses of the mechanistic concept in other disciplines (such as physics, social sciences, and engineering) to compare the commonalities and differences of "mechanistic explanation" across various fields. This interdisciplinary perspective will help students understand how life sciences can have conversations with other sciences in terms of knowledge development. Moreover, through discussion, students will gain insights into the cross-disciplinary application of terminology and concepts, deepening their philosophical understanding of biological mechanisms.

授 課 大 綱
(週次表及每週課程詳細內容說明)
Schedule

週次 Week	主題 Topics
1	Introduction (1): pilot survey and the significance of mechanisms 導論一：課程前測、機制論的重要性
2	Introduction (2): definitions and characterizations 導論二：定義與特徵
3	The historical aspect of mechanical philosophy (1): the Enlightenment period 機械哲學的歷史面向一：啟蒙時代的機械觀
4	The historical aspect of mechanical philosophy (2): modern times and the New Mechanical Philosophy

			機械哲學的歷史面向二：現代的機械觀與廿一世紀的「新機制哲學」
		5	Varieties of mechanisms 機制的多樣性與分類
		6	Mechanisms, Phenomena, and Functions: their possible relationships 機制、現象與功能：三者的可能關係
		7	The Components and Boundaries of Mechanisms (1) 機制的組成與界限（一） Midterm presentation tutorial 期中報告輔導
		8	Midterm presentation 期中報告發表
		9	The Components and Boundaries of Mechanisms (2) 機制的組成與界限（二）
		10	Strategies for Discovering Mechanisms (1): modular thinking 發現機制的策略（一）：模組形式的思維
		11	Strategies for Discovering Mechanisms (2): experimental intervention 發現機制的策略（二）：實驗干預
		12	Mechanistic Explanation and its Limits 機制論解釋及其限制
		13	Mechanisms across disciplines (1): physics 機制論與各領域（一）：物理學
		14	Mechanisms across disciplines (2): social sciences

	機制論與各領域（二）：社會科學
15	Mechanisms across disciplines (3): computer science and engineering science 機制論與各領域（三）：電腦科學與工程學
16	Reading week and final project tutorial 閱讀週與期末報告指導
17	Reading week and final project tutorial 閱讀週與期末報告指導
18	Concluding remarks 期末重點總結 Final project presentation 期末報告

每週課程詳細內容說明 Detailed lesson plan：

週次 (Week)	主題 (Topic)	活動 (Activity)
1	Introduction (1): pilot survey and the significance of mechanisms 導論（一）：課程前測、機制論的重要性	Lecture on the significance of mechanisms in knowledge development of life sciences Pilot survey: in-class discussion on students' background understanding of the concepts of "mechanical" and "mechanistic".
2	Introduction (2): definitions and characterizations	Lecture on the versions of philosophical definitions and characterizations

		導論（二）：定義與特徵	of mechanisms Case studies: car engine and window breaking
	3	The historical aspect of mechanical philosophy (1): the Enlightenment period 機械哲學的歷史面向（一）：啟蒙時代的機械觀	Lecture on the mechanical ideas in the Age of Enlightenment as represented by Newton, Descartes and Harvey
	4	The historical aspect of mechanical philosophy (2): modern times and the New Mechanical Philosophy 機械哲學的歷史面向（二）：現代的機械觀與廿一世紀的「新機制哲學」	Lecture on 19C ideas and the emergence of the New Mechanical Philosophy around 2000, including representative pioneering scholars such as Bechtel, Craver, Darden, Glennan, and Machamer.
	5	Varieties of mechanisms 機制的多樣性與分類	Lecture on dimensions for categorizing various mechanisms: phenomena, components and organizations In-class discussion of Ch7 of the essential reading.
	6	Mechanisms, Phenomena, and Functions: their possible relationships 機制、現象與功能：三者的可能關係	Lecture on some possible relationships among phenomena, functions and mechanistic explanations Case study: anemia, oxygen delivery and hemoglobin

	7	The Components and Boundaries of Mechanisms (1) 機制的組成與界限（一） Midterm presentation tutorial 期中報告輔導	Lecture on existing discussions on the ontology of mechanistic components Teacher-led tutorial on midterm project bibliographies and work-in-progress presentations
	8	Midterm presentation 期中報告	Midterm project presentation
	9	The Components and Boundaries of Mechanisms (2) 機制的組成與界限（二）	Lecture on existing philosophical discussions on the reality of boundaries of mechanisms In-class discussion of Ch9 of the essential reading.
	10	Strategies for Discovering Mechanisms (1): modular thinking 發現機制的策略（一）：模組形式的思維	Lecture on some existing philosophical accounts of the strategies for discovering mechanisms such as the notions of “schema” proposed by Craver and Darden
	11	Strategies for Discovering Mechanisms (2): experimental intervention 發現機制的策略（二）：實驗干預	Lecture on the philosophical relationships between experimental intervention and the search of mechanisms In-class discussion of Ch19 of the essential reading.
	12	Mechanistic Explanation and its Limits	Lecture on existing philosophical accounts of the possible limitations of

		機制論解釋及其限制	mechanistic explanations In-class discussion of Ch16 of the essential reading
	13	Mechanisms across disciplines (1): physics 機制論與各領域（一）：物理學	Lecture on existing philosophical accounts of the application of mechanisms in physics and its possible limitations Student-initiated, teacher-led case studies on physical science from the perspective of the philosophy of science
	14	Mechanisms across disciplines (2): social sciences 機制論與各領域（二）：社會科學	Lecture on existing philosophical accounts of the various uses of mechanisms in social sciences and some relevant problems Student-initiated, teacher-led case studies on social sciences from the perspective of the philosophy of science
	15	Mechanisms across disciplines (3): computer science and engineering science 機制論與各領域（三）：電腦科學與工程學	Lecture on existing philosophical accounts of 1. computation 2. the compatibility between engineering science and mechanism

			3. the use of mechanism for bridging engineering ans biology Student-initiated, teacher-led case studies on computer science and engineering science from the perspective of the philosophy of science
	16	Reading week and final project tutorial (by request or planned) 閱讀週與期末報告指導	Reading week and final project tutorial (by request or planned)
	17	Reading week and final project tutorial (by request or planned) 閱讀週與期末報告指導	Reading week and final project tutorial (by request or planned)
	18	Concluding remarks 期末重點總結 Final project presentation 期末報告	Lecture on concluding points of the semester Final project presentation

教科書及 延伸閱讀 Course Materials and Additional Resources	**Essential reading** The Routledge Handbook of Mechanisms and Mechanical Philosophy. Edited by Stuart Glennan and Phyllis Illari. London: Routledge, 2018. **Supplemental materials** • Case studies drawn on academic resources and trusted websites are to be added

	where applicable. • Bechtel, W. (2015). “Can mechanistic explanation be reconciled with scale-free constitution and dynamics?”, Studies in History and Philosophy of Biological and Biomedical Sciences 53, 84–93. • Machamer, Peter, Lindley Darden, and Carl F. Craver (2000). “Thinking about Mechanisms.” Philosophy of Science 67(1): 1–25. ● 蔡孟利（2023）。《生物學研究：研究什麼？如何研究？理解了什麼？》。臺北：五南圖書出版有限公司。 • 葉筱凡 （2020）。〈生物學中的機制〉，王一奇（編），《華文哲學百科》（2020 版本）。URL=http://mephilosophy.ccu.edu.tw/entry.php?entry_name=生物學中的機制。 • Supplemental readings and case studies to be assigned and distributed in accordance with course activities and emerging topics.
評 量 方 式 Grading	請勾選(可複選)，並填寫類別(Multiple Selection)：： ■課堂參與__C__類 □期 中 考____類 □期 末 考____類 ■小組報告_A_類 ■小組討論__B__類 □書面報告____類 ■課後作業_B_類 ■平時測驗_B_類 □心得分享____類 □學習紀錄____類 □專題創作____類 □其他_____類 A 類佔__70 %；B 類佔_25 %；C 類佔_5 %；D 類佔____% (類別可自行增加) Type A _70 %；Type B_25 %；Type C_5 %；Type D__% (Add if needed) • A類：期中報告 30%，期末報告 40% • B類：25%

	○ 讀物討論、案例分析 20% ■ 課後作業（10%）：將指定讀物閱讀完畢，並以小組為單位，依照題綱準備報告筆記 ■ 課堂分組口頭報告（含回應教師問題）（10%） ○ 隨堂測驗 5% • C類：5%，以課堂簡短報告、組員互動、繳交課堂測驗答案等教師與助教可觀察之方式，顯示實際之參與。 Detail: • Illegal photocopying of copyrighted course books is strictly prohibited. • The course materials are for internal education use only. Copyrighted materials may be used reasonably within this educational environment and must not be disseminated elsewhere. Profitable uses are strictly prohibited. • Group assignment: required readings or case studies are assigned a week prior to the in-class discussion. In the discussion, students are required to present their findings and respond to follow-up questions from the instructor and their classmates. See course schedule for details. • Midterm project: case study-based group engagement. By answering the required questions, students are expected to demonstrate their acquired knowledge about the concepts taught, their critical analytical skills, and their abilities to teamwork and communicate professionally. • Semester project: the same as the midterm project, except that students are further expected to demonstrate their ability to coherently draw on all the ideas taught throughout the semester. • Assessment criteria for midterm and semester projects:

- use of knowledge taught 25%
- logic flow 25%
- structure 20%
- connection of argument to knowledge taught 20%
- citation 5%
- time and word count management 5%

- Case analyses, in-class quizzes, discussions, and required reading discussions are graded. An absence without legitimate leave results in a 55 for the occasion.
- On the presentation days of the midterm and the semester projects, leave must be requested in accordance with university regulations.

說明：

- 校方統一規定：尊重智慧財產權，不得非法影印教師指定之教科書籍！
- 平時作業：一週前公告閱讀範圍，次週課堂報告，回應師生提問，確切閱讀章節詳於各週次之授課內容。
- 平時測驗：以隨堂案例分析為主，要求學生即席運用當次講授之概念，分析討論日常生活中相對較為簡單的案例，為半開放式問題，答案須符合正確的分析方向，而可彈性活用、延伸。作答語言原則上為英文，惟可依照學習需求由教師當場判斷，容許使用不超過答案篇幅40%之華語文。
- 期中報告：小組之案例分析，就指定之概念（至第七週所講授範圍）搜尋、彙整實際案例相關資料，查閱並引用理論文獻，提出獨立見解。
- 期末報告：小組之案例分析，就指定之概念（全學期講授範圍之綜合）搜尋、彙整實際案例相關資料，查閱並引用理論文獻，提出獨立見解。
- 期中與期末報告評分架構：

  I. 所授知識之運用 25%

	II. 報告論點與所授知識之連結 20% III. 學術引用格式 5% IV. 字數與時間控制 5% 2. 案例分析、隨堂測驗與研討、必讀計分討論，無故缺課則當次 55 分。 3. 期中、期末報告，若有不可抗力之因素導致必須缺席，需依校方規定請假。無故缺席或遲到，依缺席時間所佔該組報告時間比例扣個人報告總分。 4. 課程所有作業報告均僅接受電子檔。 5. 教材僅供課堂內部使用，限於此教育環境內合理使用具版權之資料，不可傳播於課程外之對象，嚴格禁止用於營利。 I. 論述邏輯 25% II. 報告結構安排 20%
與聯合國永續發展目標(SDGs)及細項之對應(請參閱 SDGs 對照表) UN SDGs Goals and Targets	目標 Goal: 4 細項 Target： 4.7 目標 Goal: 9 細項 Target： 9.5 目標 Goal: 17 細項 Target： 17.17 (至多三個目標，每個目標至多三個細項) (3 Goals at most, 3 Targets at most for each Goal) 範例： 目標: 4 細項：4.3 4.5 4.7
核心能力指標設定 Core Ability Goals	通識課程 核心能力指標 (請勾選主要的 3-5 項) Core Abilities of General Education (Select 3-5 main) | 說明 Detail | 課程能培養學生此項核心能力者請打 Select if

	Goals)		Correlated ✓
	(1)思考與創新 Thinking and Innovation	能夠進行獨立性、批判性、系統性或整合性等面向的思考，或能以創意的角度來思考新事物。	✓
	(2)道德思辨與實踐 Moral Thinking and Application	能夠對於社會、文化中相關的倫理或道德議題，進行明辨、慎思與反省，或能實踐在日常生活中。	
	(3)生命探索與生涯規劃 Life Exploration and Career Planning	能夠主動探索自我的價值或生命的真諦，或能具體實踐在自我生涯的規劃或發展。	✓
	(4)公民素養與社會參與 Citizenship and Community Engagement	能夠尊重民主與法治的精神、關心公共事務及議題，或能參與社會事務及議題的討論與決策。	
	(5)人文關懷與環境保育 Humanity and Environment Protection	能夠具備同理、關懷、尊重、惜福等人文素養，或能擴及到更為廣泛的環境及生態議題。	✓
	(6)溝通表達與團隊合作 Communication Skills and Teamwork	能夠善用各種不同的表達方式進行有效的人際溝通，或能理解組織運作，與他人完成共同的事物或目標。	✓
	(7)國際視野與多元文化	能夠了解國際的情勢與脈	

	Global Perspectives and Cultural Differences	動，具備廣博的世界觀，或能尊重或包容不同文化間的差異。	
	(8)美感與藝術欣賞 Art Appreciation	能夠領略各種知識、事物或領域中的美感內涵，或能據此促成具美感內涵之實踐力。	
	(9)問題分析與解決 Problem Solving	能夠透過各種不同的方式發現問題，解析問題，或能進一步透過思考以有效解決問題。	✓
備註 Note	全文完		