

# 國立中正大學課程大綱

## National Chung Cheng University Syllabus

課號 course code		全英文授課 EMI	<input checked="" type="checkbox"/> 是 <input type="checkbox"/> 否
課程類別 course type	<input type="checkbox"/> 人文關懷課程 <input type="checkbox"/> 競賽專題課程 <input checked="" type="checkbox"/> 問題導向課程 <input checked="" type="checkbox"/> 專題導向課程 <input type="checkbox"/> 總整課程 <input type="checkbox"/> 實作課程 <input type="checkbox"/> 實習 <input type="checkbox"/> 其他		
課程名稱 ( 中文 ) Chinese course name	地震電磁學		
課程名稱 ( 英文 ) English course name	Seismo-electromagnetics		
學年/學期 academic year /semester	113 學年第 1 學期	學分 credits	3
學系 ( 所 ) department		必選修 required/selected	<input type="checkbox"/> 必修 <input checked="" type="checkbox"/> 選修
上課時間 class hours	Thursday 3.4.5	上課地點 classroom	地震館 304 教室
教師 instructor	Hong-Jia Chen (陳宏嘉)	教師 email Instructor's email	hongjia@ccu.edu.tw
助教 teaching assistant		助教 email TA's email	
先修科目或 先備能力 prerequisites	No prerequisites Audience: Graduate students		
課程概述 course descriptions	<p>To forecast when and where strong earthquakes are likely to occur, seismologists usually apply statistics to monitor how seismic activities evolve through time. However, this method often fails to anticipate the time and magnitude of strong earthquakes. Although earthquake forecasting has been traditionally focused on mechanical quantities (e.g., stress, strain, seismicity) and has viewed their variations mainly as signs before large events, a different school has developed for decades outside the field of seismology, dealing with quantities considered as observable tracers, such as electromagnetic and chemical quantities. Those non-mechanical phenomena appear rather exotic to the mainstream community of seismologists. Such phenomena can be observed days or even weeks before strong earthquakes occur. In addition, it has been statistically reported that electromagnetic precursors are the most promising methodology for short-term earthquake forecasting.</p> <p>The initiative is rationalized via a subtle atomic-level defect-based mechanism for explaining a variety of earthquake precursors, building on decades of laboratory experiments in physical chemistry and solid-state physics. The theory suggests that, as stresses build up in tectonic plates</p>		

	before seismic activity, electron-hole pairs are generated in the Earth' s crust. The electrons are confined to the stressed rocks, but the positively charged holes flow out into the surrounding, less stressed rocks, producing electrical currents that can travel over large distances. These currents in turn can trigger wide-ranging secondary effects ranging from unusual low to ultralow electromagnetic radiation, to emissions of spectroscopically distinct thermal infrared from the Earth' s surface, to changes in the atmosphere and ionosphere.
<b>學習目標</b> <b>learning objectives</b>	The objective of this course is to introduce the topic entitled "Seismo-electromagnetics: Electromagnetic phenomena during the process of earthquake preparation and occurrence," to shed light on the solid-state theory of Friedemann Freund and other possible generation mechanisms of electromagnetic precursors, and to review the articles regarding electromagnetic precursors. This course also documents the findings of researchers around the world, who have used both ground- and space-based observations to link these non-seismic patterns to the occurrence of subsequent strong earthquakes. The course teaches students regarding global efforts to continually monitor the Earth for key signs of these precursors, which are often intermittent and weak.
<b>教科書及參考書</b> <b>textbooks and references</b>	<ol style="list-style-type: none"> <li>1. Ikeya, M. (2004). Earthquakes and Animals: From Folk Legends to Science. Singapore: World Scientific.</li> <li>2. Ouzounov, D., Pulinets, S., Hattori, K., &amp; Taylor, P. (Eds.). (2018). Pre-Earthquake Processes: A Multidisciplinary Approach to Earthquake Prediction Studies. Hoboken, New Jersey, U.S.A.: John Wiley &amp; Sons.</li> <li>3. Freund, F., Mignan, A., Ouillon, G., &amp; Sornette, D. (Eds.). (2021). The Global Earthquake Forecasting System: Towards Using Non-seismic Precursors for the Prediction of Large Earthquakes. Berlin/Heidelberg, Germany: Springer.</li> </ol>
<b>教學要點概述</b>	
<b>教材編選</b> <b>teaching materials</b>	<input checked="" type="checkbox"/> 自製簡報(ppt) <input type="checkbox"/> 課程講義 <input type="checkbox"/> 自編教科書 <input type="checkbox"/> 教學程式 <input type="checkbox"/> 自製教學影片 <input type="checkbox"/> 其他
<b>教學方法</b> <b>teaching methods</b>	<input checked="" type="checkbox"/> 講述 <input checked="" type="checkbox"/> 小組討論 <input checked="" type="checkbox"/> 學生口頭報告 <input checked="" type="checkbox"/> 問題導向學習 <input type="checkbox"/> 個案研究 <input type="checkbox"/> 其他
<b>評量工具</b> <b>Evaluation tools</b>	<input type="checkbox"/> 期中考 <input type="checkbox"/> 期末考 <input type="checkbox"/> 隨堂測驗 <input type="checkbox"/> 隨堂作業 <input checked="" type="checkbox"/> 課後作業 <input type="checkbox"/> 期中報告 <input checked="" type="checkbox"/> 期末報告 <input checked="" type="checkbox"/> 專題報告 <input type="checkbox"/> 評量尺規 <input type="checkbox"/> 其他
<b>教學資源</b> <b>teaching resources</b>	<input type="checkbox"/> 課程網站 <input checked="" type="checkbox"/> 教材電子檔供下載 <input type="checkbox"/> 實習網站
<b>教師</b> <b>相關訊息</b> <b>instructor's information</b>	Research interests: Seismo-electromagnetics, statistical seismology, geophysical exploration <a href="https://www.researchgate.net/profile/Hong-Jia-Chen">https://www.researchgate.net/profile/Hong-Jia-Chen</a>

每週課程內容 weekly scheduled contents						
Week 1 (9/12) Historical Development of Pre-Earthquake Phenomena Studies						
Week 2 (9/19) Latest Physical Models and Concepts of Pre-Earthquake Processes						
Week 3 (9/26) Latest Physical Models and Concepts of Pre-Earthquake Processes						
Week 4 (10/3) Pre-Earthquake Seismic Phenomena						
Week 5 (10/10) Holiday						
Week 6 (10/17) Pre-Earthquake Seismic Phenomena						
Week 7 (10/24) Laboratory Experiments of Rock Compression Tests						
Week 8 (10/31) Laboratory Experiments of Rock Compression Tests						
Week 9 (11/7) Ground Geochemical and Electromagnetic Observations of Major Seismicity						
Week 10 (11/14) Ground Geochemical and Electromagnetic Observations of Major Seismicity						
Week 11 (11/21) Atmospheric/Thermal Signals Associated with Major Earthquakes						
Week 12 (11/28) Atmospheric/Thermal Signals Associated with Major Earthquakes						
Week 13 (12/5) Ionospheric Processes Associated with Major Earthquakes						
Week 14 (12/12) Ionospheric Processes Associated with Major Earthquakes						
Week 15 (12/19) Interdisciplinary Approach to Earthquake Forecasts/Predictions						
Week 16 (12/26) Interdisciplinary Approach to Earthquake Forecasts/Predictions						
Week 17 (1/2) Final Report						
Week 18 (1/9) Final Report						
核心能力 core competencies						
核心能力 Core competency		本課程與核心能力關聯強度 Degrees of related to core competencies				
		1	2	3	4	5
專業能力 Specific competency	1. 善用人工智慧與深度學習解決問題。			V		
	2. 具備國際溝通、協調及交流能力。					V
	3. 兼顧策略性及成本效應之專案撰寫與執行力。				V	
共通能力 General Competence	1. 具備批判性思考、獨立研究及創業創新能力。					V
	2. 提升文獻資料整合及英文科技論文寫作能力。					V
	3. 掌握尖端地球科學技術並解決關鍵問題。					V
	4. 具備資料分析歸納、創新思考能力。					V

註：關聯強度以五點量表標示，1 表示沒有關聯，5 表示非常有關聯。