中正大學 資訊工程研究所 課程大綱

<table>
<tr><td>課程名稱(中文)
(Chinese Course type)</td><td>無線通訊技術與安全</td><td>開課單位
(Department)</td><td>資訊工程研究所</td></tr>
<tr><td rowspan="3">課程名稱(英文)
(English Course name)</td><td rowspan="3">Wireless Communication Technology and Security</td><td>課程代碼
(Course code)</td><td>4105483 (班別 01)</td></tr>
<tr><td>上課時間</td><td>一B、一C</td></tr>
<tr><td>上課地點</td><td>創新大樓 322</td></tr>
<tr><td>授課教師
(Instructor)</td><td>江宗韋</td><td>學分數
(Credits)</td><td>3</td></tr>
<tr><td>必/選修
(Required/Selected)</td><td>☐ 必修 ☑ 選修</td><td>開課年級
(Level)</td><td>研究所(碩博合開，開放大三大四選修)</td></tr>
<tr><td>課程屬性/類別
(Course type)</td><td colspan="3">☐ 人文關懷課程 ☐ 競賽專題課程 ☐ 問題導向課程
☐ 專題導向課程 ☐ 總整課程 ☐ 實作課程
☐ 實習 ☑ 其他</td></tr>
<tr><td>先修科目或先備能力
(Prerequisites)</td><td colspan="3">It is better to have basic knowledge of linear algebra and probability theory.</td></tr>
<tr><td>課程概述
(Course Descriptions)</td><td colspan="3">This course introduces key concepts of 5G New Radio (NR) mobile communications and emphasizes security research for next-generation (6G) systems. It highlights practical, link-level wireless communication principles essential to 5G NR and integrates hands-on operations. As a graduate-level offering, the course also explores current research trends in 6G development. Designed to provide a foundational understanding of 5G NR, the course aims to narrow the gap between academic knowledge and industry applications. Students will acquire practical knowledge and investigate relevant security and privacy issues within these advanced communication technologies.</td></tr>
<tr><td>學習目標
(Learning Objectives)</td><td colspan="3">1. Understand basics of 5G NR mobile communication
2. Conduct 5G NR link-level simulations through hands-on coding in Python, MATLAB, or C++.
3. Understand research topics related to 6G, including the exploration of security issues.</td></tr>
<tr><td>教科書
(Textbooks and Reference)</td><td colspan="3">No specific textbook is prescribed for this course as the materials are drawn from a diverse array of sources.

The references used are from reputable sources to provide a foundational understanding of 5G NR technologies.

References:
1. Erik Dahlman, Stefan Parkvall, Johan Sköld, 5G/5G-</td></tr>
</table>

	Advanced: The Next Generation Wireless Access Technology. 3rd Edition, Academic Press, 2024. 2. Ali Zaidi, Fredrik Athley, Jonas Medbo, Ulf Gustavsson, Giuseppe Durisi, Xiaoming Chen, ***5G Physical Layer: Principles, Models and Technology Components***. Academic Press, 2018. 3. Mosa Ali Abu-Rgheff, ***5G Physical Layer Technologies***. John Wiley & Sons, 2020. 4. 3GPP Specifications per TSG/WG. 5. 李大嵩、李明峻、詹士慶、吳昭沁, ***第五代行動通訊系統 3GPP New Radio(NR)：原理與實務***. 全華圖書, 2021.

課程大綱(Course Syllabus)		分配時數 (Number of Hours)	核心能力 (Core Capabilities)
單元 主題(Topic)	內容綱要(Content)	講授 (Lecture)	
1. Introduction to The Course and Overview	A brief overview of 5G NR mobile communication	4	■ A1 □A2 □A3 □A4 □A5 □A6 □A7 ■ A8
2. Wireless Channel Model for 5G	Knowledge of 3D channel model and fading effects	6	■ A1 ■ A2 ■ A3 ■ A4 □A5 □A6 □A7 ■ A8
3. Multi-carrier Transmission	Introduction to OFDM transceiver, channel estimation, signal detection, and non-ideal effects	5	■ A1 ■ A2 ■ A3 ■ A4 □A5 □A6 □A7 ■ A8
4. Multi-antenna Technology for 5G	Introduction to beamforming, MIMO precoding, and signal processing	6	■ A1 ■ A2 ■ A3 ■ A4 □A5 □A6 □A7 ■ A8
5. 5G NR System and Technology	Introduction to key technology, network architecture, communication protocols, physical transmission resources	6	■ A1 ■ A2 ■ A3 ■ A4 □A5 □A6 □A7 ■ A8
6. 5G NR Physical	Introduction to topics of reference	6	■ A1 ■ A2

Layer Signal Processing	signals, transport channel processing, downlink and uplink physical processing		■A3 ■A4 □A5 □A6 □A7 ■A8
7. 5G NR Physical Layer Operation Mechanisms	Introduction to topics of control signals, beam management, mmWave, transmission patterns, sidelink, and mTRP	6	■ A1 ■A2 ■A3 ■A4 □A5 □A6 □A7 ■A8
8. Advanced Technology in 5G	Introduction to advanced technology, such as URLLC, IoT, V2X, Positioning, spectrum sharing, NTN, and more	5	■ A1 ■A2 ■A3 ■A4 □A5 □A6 □A7 ■A8
9. Private and Secure Technology (I)	Introduction to research topics of privacy-preserving wireless technology for 6G and AI	5	■ A1 ■A2 ■A3 ■A4 □A5 □A6 □A7 ■A8
10. Private and Secure Technology (II)	Introduction to research topics for 6G, including secure wireless technology	5	■ A1 ■A2 ■A3 ■A4 □A5 □A6 □A7 ■A8

教育目標

1.具獨立從事學術研究或產品創新研發之人才
2.具團隊合作精神及科技整合能力，並在團隊中扮演領導、規劃、管理之角色
3.具創新研發、自我挑戰與終身學習能力之人才
4.具有學術倫理、工程倫理、國際觀之人才

核心能力

A1.具有資訊工程與科學領域之專業知識(Competence in computer science and computer engineering.)
A2.具有創新思考、問題解決、獨立研究之能力(Be creative and be able to solve problems and to perform independent research.)
A3.具有撰寫中英文專業論文及簡報之能力(Demonstrate good written, oral, and communication skills, in both Chinese and English.)
A4.具策劃及執行專題研究之能力(Be able to plan and execute projects.)
A5.具有溝通、協調、整合及進行跨領域團隊合作之能力(Have communication, coordination, integration skills and teamwork in multi-disciplinary settings.)
A6.具有終身學習與因應資訊科技快速變遷之能力(Recognize the need for, and have the ability to engage in independent and life-long learning.)

A7. 認識並遵循學術與工程倫理(Understand and commit to academic and professional ethics.)
A8. 具國際觀及科技前瞻視野(Have international view and vision of future technology.)

請尊重智慧財產權，不得非法影印教師指定之教科書籍
(Please respect to the intellectual property rights, do not photocopy the textbooks which assigned by professors.)

教學要點概述	
教材編選 (Teaching Materials)	■自製簡報(ppt) ■課程講義 ■教學程式
教學方法 (Teaching Methods)	■投影片講述 ■板書講述
評量工具 (Evaluation Tools)	■上課點名 10% ■隨堂作業 30% ■程式實作 30% ■期末報告 30%
教學資源 (Teaching Resources)	■課程網站 ■教材電子檔供下載 ■實習網站
教師相關訊息 (Instructor's Information)	請學生尊重智慧財產權及使用正版教科書。 Students should respect intellectual property rights and use authorized textbooks.
教學相關配合事項 (Course relative information)	Plagiarism is strictly prohibited for all homework and assignments, including code and reports. Any student found engaging in plagiarism will automatically fail the course.

課程目標與教育核心能力相關性	
請勾選：☑ A1 ☑ A2 ☑ A3 ☑ A4 ☐ A5 ☐ A6 ☐ A7 ☑ A8	
A1	**具有資訊工程與科學領域之專業知識**(Competence in computer science and computer engineering.)
	為何有關： The course content covers the fundamental knowledge of 5G NR mobile communications and related privacy and security introductions, aiming to cultivate students' professional knowledge from a systematic perspective in the field of information and communication.
	達成指標： Grades are determined by assignments, practical programming tasks, and the final (project) report. Graduate students must achieve a score of over 70, and undergraduates must exceed 60 to pass.
	評量方法： Assessment Criteria for Assignments, Programming Projects, and the Final (Project) Report: • Level 5: Submission of 80% of assignments and an anticipated semester grade of 80 points or above, or a report grade of 80 points or above. • Level 4: Submission of 60% of assignments and an anticipated semester grade of 70 points or above, or a report grade of 70 points or above. • Level 3: Submission of 40% of assignments and an anticipated semester grade of 60 points or above, or a report grade of 60 points or above. • Level 2: Submission of 20% of assignments and an anticipated semester grade of 50 points or above, or a report grade of 50 points or above. • Level 1: No assignment submissions or an anticipated semester grade of less than 50 points, or a report grade of less than 50 points.
A2	**具有創新思考、問題解決、獨立研究之能力**(Be creative and be able to solve problems and to perform independent research.)
	為何有關： Assignments integrate practical experience; students are required to write programming implementations to enhance their ability to independently solve practical and interesting problems. Assignments will also include reading academic literature and providing concrete summaries.
	達成指標： Students are encouraged to participate in discussions and bravely attempt solutions, but must complete their assignments independently. Flaws or errors in assignments are entirely acceptable, as there may not always be an absolute correct answer. Plagiarism is strictly prohibited for all homework and assignments.
	評量方法： Same as the Assessment Criteria outlined in A1.

A3	**具有撰寫中英文專業論文及簡報之能力**(Demonstrate good written, oral, and communication skills, in both Chinese and English.)
	為何有關： Students are required to complete the final project report in English, clearly articulating the motivation, logical reasoning, methodology, and outcomes.
	達成指標： The final project report should be clear, easy to follow, logically sound, and systematically organized.
	評量方法： Same as the Assessment Criteria outlined in A1.
A4	**具策劃及執行專題研究之能力**(Be able to plan and execute projects.)
	為何有關： Students will base their work on programming assignments to complete a final project report. The report should clearly present the motivation, methodology, results, and possible innovations.
	達成指標： The final project report should be clear, easy to follow, logically sound, and systematically organized.
	評量方法： Same as the Assessment Criteria outlined in A1.
A8	**具國際觀及科技前瞻視野**(Have international view and vision of future technology.)
	為何有關： Assignments will include tasks for students to read the latest academic articles and produce summaries. Students are required to learn about current 5G mobile communications knowledge as well as the potential developments in the future 6G system.
	達成指標： Students can study international journals and conference papers, and are able to accurately summarize and analyze their contents.
	評量方法： Same as the Assessment Criteria outlined in A1.