

國立中正大學課程大綱(CCU Course Syllabus)

電機工程研究所(Graduate Institute of Electrical Engineering)

|                                     |                                                                                                                                                                                                                                                                                                                                                                                      |                              |                                                  |                 |     |
|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------------------------------------|-----------------|-----|
| 課程名稱(中文)<br>(Chinese Course Title)： | 毫米波積體電路                                                                                                                                                                                                                                                                                                                                                                              | 開課單位<br>(Teaching Unit)：     | 電機工程研究所<br>(Institute of Electrical Engineering) |                 |     |
| 課程名稱(英文)<br>(English Course Title)： | Millimeter Wave<br>Integrated Circuit                                                                                                                                                                                                                                                                                                                                                | 課程代碼<br>(Course Code)：       | 4156199_01/4456265_01                            |                 |     |
| 授課教師(Lecturer)：                     | 吳建華                                                                                                                                                                                                                                                                                                                                                                                  |                              |                                                  |                 |     |
| 學分數<br>(Number of Credits)：         | 3                                                                                                                                                                                                                                                                                                                                                                                    | 必/選修<br>(Mandatory/Elective) | 選修(Elective)                                     | 開課年級<br>(Year)： | 研究所 |
| 先修科目或先備能力<br>(Prerequisites)：       |                                                                                                                                                                                                                                                                                                                                                                                      |                              |                                                  |                 |     |
| 課程概述<br>(Course Introduction)：      | To illustrate the state-of-the-art microwave and millimeter-wave integrated circuit technologies                                                                                                                                                                                                                                                                                     |                              |                                                  |                 |     |
| 學習目標<br>(Learning Goals)：           | 1. .To provide the related knowledge about microwave and millimeter-wave application.<br>2. .To explain the design considerations of integrated circuits for millimeter-wave frequency<br>3. To understand how they are assembled into a system                                                                                                                                      |                              |                                                  |                 |     |
| 教科書(Textbook)：                      | Reference:<br>1. Millimeter-wave Circuits for 5G and Radar, edited by Gernot Hueber and Ali M. Niknejad, Cambridge University Press, ISBN 9781108492782, 2019 (Online ISBN: 9781108686396)<br>2. mm-Wave Silicon Power Amplifiers and Transmitters, Edited by Hossein Hashemi, and Sanjay Raman, Cambridge University Press, ISBN: 9781107055865, 2016. (Online ISBN: 9781107295520) |                              |                                                  |                 |     |

| 課程大綱(Course Syllabus)                          |               | 分配時數(Number of Hours) |                       |                    |                | 核心能力<br>(Core Capabilities) | 備註<br>(Remarks) |
|------------------------------------------------|---------------|-----------------------|-----------------------|--------------------|----------------|-----------------------------|-----------------|
| 單元主題<br>(Topic)                                | 內容綱要(Content) | 講授<br>(Lecture)       | 示範<br>(Demonstration) | 習作<br>(Assignment) | 其他<br>(Others) |                             |                 |
| 1. Transceivers Models and Analysis            |               | 9                     |                       |                    |                | 1.1,                        |                 |
| 2. CMOS Millimeter-Wave Transceiver Design     |               | 9                     |                       |                    |                | 1.2,                        |                 |
| 3. Millimeter-Wave CMOS Power Amplifier Design |               | 9                     | 3                     | 9                  |                | 1.3,                        |                 |
| 4. Millimeter-Wave VCO Design                  |               | 9                     |                       | 9                  |                | 2.1,                        |                 |
| 5. Millimeter-Wave CMOS SoC                    |               | 6                     |                       |                    |                | 2.2                         |                 |
| 6. Millimeter-Wave Phased Arrays               |               | 6                     |                       |                    | 6              | 3.1                         |                 |

|                                                  |   |  |  |   |     |  |
|--------------------------------------------------|---|--|--|---|-----|--|
| 7. Scalable Millimeter-Wave Multibeam Approaches | 9 |  |  | 3 | 4.1 |  |
| 8. Massive MIMO Radios                           | 6 |  |  |   | 4.3 |  |
| 9. Millimeter-Wave full-Duplex Radio             | 6 |  |  |   | 4.4 |  |
| 10. Millimeter-Wave Frequency Synthesis          | 6 |  |  |   |     |  |

### 教育目標(Education Goals)

- 1.專業素養. 傳授學生電機工程專業領域知識，並能進一步結合理論與實務進行研究。
- 2.創新研發. 訓練學生發掘與分析解決問題的能力。
- 3.團隊合作. 訓練學生良好的溝通技巧，並培養團隊合作的能力。
- 4.產業趨勢. 培養學生瞭解國內外學術與產業之發展與需求，並理解工程倫理及社會責任。

### 核心能力(Core Capabilities)

- 1.1. 學習電機工程相關領域之理論基礎。Acquiring of theoretical knowledge in Electrical Engineering.
- 1.2. 瞭解電機工程相關領域之實務技術。Understanding of practical techniques in Electrical Engineering.
- 1.3. 訓練專業論文寫作與簡報的能力。Ability to write technical documents and make effective presentations.
- 2.1. 培養發掘與分析電機工程特定領域專題研究之能力。Ability to identify, formulate and analyze problems in specified areas of Electrical Engineering.
- 2.2. 培養規劃與執行電機工程特定領域專題研究之能力。Ability to plan and conduct projects in specified areas of Electrical Engineering.
- 3.1. 學習溝通與表達的能力。Ability to communicate and express effectively.
- 3.2. 運用個人專長，與團隊成員合作達成計畫目標。Ability to contribute effectively as an individual, and as a member or leader in team works.
- 4.1. 瞭解國內外電機工程特定領域產業現況。 Understanding of the trend of both domestic and global industry in specified areas of Electrical Engineering.
- 4.2. 理解工程倫理及社會責任。Understanding of engineering ethics and social responsibilities.
- 4.3. 培養良好的國際觀。 Development of global perspectives.
- 4.4. 培養科技英文能力。 Proficiency in technical English.

(Please respect to the intellectual property rights, do not photocopy the textbooks which assigned by professors.)

|                                                                                   |                                                                               |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| 課程目標與教育核心能力相關性(Relationship between course education goals and core capabilities) |                                                                               |
| 如有未出現的核心能力，請先按『確定』送出資料                                                            |                                                                               |
| 請勾選(Please select)：                                                               |                                                                               |
| 1.1                                                                               | 學習電機工程相關領域之理論基礎。Acquiring of theoretical knowledge in Electrical Engineering. |

|     |                                                                                                                                         |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------|
|     | 為何有關：Focus on the newly-developed technology related to the mmWave CMOS IC Design                                                       |
|     | 達成指標：Understand the theoretical background understanding the flow of mmWave CMOS circuit design                                         |
|     | 評量方法：Literature-review, presentation and project                                                                                        |
| 1.2 | <b>瞭解電機工程相關領域之實務技術。 Understanding of practical techniques in Electrical Engineering.</b>                                                |
|     | 為何有關：Focus on the newly-developed millimeter-wave application                                                                           |
|     | 達成指標：Understand the industrial trend and status                                                                                         |
| 1.3 | 評量方法：Technique-report review presentation                                                                                               |
|     | <b>訓練專業論文寫作與簡報的能力。 Ability to write technical documents and make effective presentations.</b>                                           |
|     | 為何有關：In this course, all of activities are based on reports and presentations.                                                          |
| 2.1 | 達成指標：Technical report writing and oral presentation                                                                                     |
|     | 評量方法：Documentation on review-report and oral presentation                                                                               |
|     | <b>培養發掘與分析電機工程特定領域專題研究之能力。 Ability to identify, formulate and analyze problems in specified areas of Electrical Engineering.</b>        |
| 2.2 | 為何有關：Investigation on the newly-developed millimeter-wave application and technology                                                    |
|     | 達成指標：Identify the unresolved technical issue and figure-out the possible remedy                                                         |
|     | 評量方法：Project                                                                                                                            |
| 2.2 | <b>培養規劃與執行電機工程特定領域專題研究之能力。 Ability to plan and conduct projects in specified areas of Electrical Engineering.</b>                       |
|     | 為何有關：Cultivate the skills to solve the newly-developed millimeter-wave circuit design issues                                            |
|     | 達成指標：Project planning and conducting                                                                                                    |
| 3.1 | 評量方法：Project                                                                                                                            |
|     | <b>學習溝通與表達的能力。 Ability to communicate and express effectively.</b>                                                                      |
|     | 為何有關：A well carry-out on project needs clearly expressing issues and close collaboration with other team members                        |
| 4.1 | 達成指標：highlight the issue point and interosculate with others                                                                            |
|     | 評量方法：Project                                                                                                                            |
|     | <b>瞭解國內外電機工程特定領域產業現況。 Understanding of the trend of both domestic and global industry in specified areas of Electrical Engineering.</b> |
| 4.3 | 為何有關：Catch on the current status of millimeter-wave technology                                                                          |
|     | 達成指標：Understand the industrial developing status                                                                                        |
|     | 評量方法：Report                                                                                                                             |
| 4.3 | <b>培養良好的國際觀。 Development of global perspectives.</b>                                                                                    |
|     | 為何有關：The understanding of the current status of microwave and millimeter-wave technology                                                |

|     |                                                                                            |
|-----|--------------------------------------------------------------------------------------------|
|     | is global, not limited to domestic.                                                        |
|     | 達成指標：Summary the global achievements of 5 years                                            |
|     | 評量方法：Report                                                                                |
| 4.4 | <b>培養科技英文能力。 Proficiency in technical English.</b>                                         |
|     | 為何有關：Most of the industry and academic situation and information are announced by English. |
|     | 達成指標：Reading and writing of technical report.                                              |
|     | 評量方法：Report                                                                                |