

课程大纲

COURSE SYLLABUS

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| 1. | 课程代码/名称 Course Code/Title | 微能量采集电路设计 Energy Harvesting Circuit and System Design |
| 2. | 课程性质 Compulsory/Elective | 选修 Elective |
| 3. | 开课单位 Offering Dept. | 深港微电子学院 School of Microelectronics |
| 4. | 课程学分/学时 Course Credit/Hours | 3/48 |
| 5. | 授课语言 Teaching Language | 英语 English |
| 6. | 授课教师 Instructor(s) | 李嘉敏 Jiamin Li |
| 7. | 开课学期 Semester | 春季 Spring |
| 8. | 是否面向本科生开放 Open to undergraduates or not | 否 No |
| 9. | 先修要求 Pre-requisites | (如面向本科生开放, 请注明区分内容。 If the course is open to undergraduates, please indicate the difference.) 无 None |
| 10. | 教学目标 Course Objectives | <p>(如面向本科生开放, 请注明区分内容。 If the course is open to undergraduates, please indicate the difference.)</p> <p>微能量采集与管理电路广泛应用于低功耗片上系统中, 如物联网、可穿戴及植入式设备。本课程旨在介绍传统及新兴能量采集器的电路模型、设计考虑、基本电路单元、最大功率点跟踪、前沿电路与架构的优化技术等, 使学生掌握面向能量采集的集成电路设计基础理论, 培养低功耗下设计思维。通过对学术界及业界前沿设计的分析讨论, 使学生了解当前挑战、技术进展及趋势, 加深对集成电路设计的理解, 并培养其运用电路技术分析解决现实应用问题的能力。</p> <p>Energy harvesting and management circuit has been widely used in low-power System-on-Chips (SoCs), with applications ranging from general Internet-of-Things (IoT) edge devices to wearable and implantable devices. This course will introduce the electrical models of some representative and emerging energy harvesters, design considerations, essential circuit building blocks, maximum power point tracking, as well as the state-of-the-art circuit and system optimization techniques. The goal of the course is to enable students to understand the integrated circuit and system designs for energy harvesting, and the design methodologies for low-power applications. Through analysis and discussions on the cutting-edge designs from both the industry and academia, students are expected to have an awareness of the challenges, technical progresses, and the trend. They are also expected to be able to evaluate a circuit design critically, to translate system specifications, and to use circuit techniques to address real-world application problems.</p> |
| 11. | 教学方法 Teaching Methods | <p>(如面向本科生开放, 请注明区分内容。 If the course is open to undergraduates, please indicate the difference.)</p> <p>理论讲授、课题讨论、学生报告 Lectures, seminars, and presentations</p> |

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| 12. 教学内容 Course Contents (如面向本科生开放, 请注明区分内容。 If the course is open to undergraduates, please indicate the difference.) | |
| Section 1 | 能量收集系统概述-1 Energy harvesting system overview-1 |
| Section 2 | 能量收集系统概述-2 Energy harvesting system overview-2 |
| Section 3 | 无源整流器 Passive rectifier |
| Section 4 | 有源整流器 Active rectifier |
| Section 5 | 电容型直流-直流转换器-1 Switched-capacitor based power converter-1 |
| Section 6 | 电容型直流-直流转换器-2 Switched-capacitor based power converter-2 |
| Section 7 | 电感型直流-直流转换器-1 Inductor-based power converter-1 |
| Section 8 | 电感型直流-直流转换器-2 Inductor-based power converter-2 |
| Section 9 | 电磁波能量收集系统设计 Electromagnetic energy harvesting system design |
| Section 10 | ISSCC 文章鉴赏 ISSCC paper review |
| Section 11 | 光伏能量收集系统设计 Photovoltaic energy harvesting system design |
| Section 12 | ISSCC 文章鉴赏 ISSCC paper review |
| Section 13 | 热电能量收集系统设计 Thermoelectric energy harvesting system design |
| Section 14 | ISSCC 文章鉴赏 ISSCC paper review |
| Section 15 | 压电能量收集系统设计 Piezoelectric energy harvesting system design |
| Section 16 | ISSCC 文章鉴赏 ISSCC paper review |
| Section 17 | 新兴能量收集系统设计 System design for emerging energy harvesters |
| Section 18 | ISSCC 文章鉴赏 ISSCC paper review |

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| Section 19 | 多能量收集系统设计 Multi-input energy harvesting system design |
| Section 20 | ISSCC 文章鉴赏 ISSCC paper review |
| Section 21 | 学生报告 Student Presentations |
| Section 22 | 学生报告 Student Presentations |
| Section 23 | 学生报告 Student Presentations |
| Section 24 | 学生报告 Student Presentations |
| 课程考核 Course Assessment | |
| 13. | <p>(① 考核形式 Form of examination; ②. 分数构成 grading policy; ③ 如面向本科生开放, 请注明区分内容。 If the course is open to undergraduates, please indicate the difference.)</p> <p>考查 出勤 Attendance 20% 课堂表现 Class Performance 30% 期末报告 Presentation 50%</p> |
| 教材及其它参考资料 Textbook and Supplementary Readings | |
| 14. | <p>无教材 No textbook 参考资料 Supplementary Readings (Optional)</p> <ol style="list-style-type: none"> 1. Hehn, T., Manoli, Y. (2015). CMOS Circuits for Piezoelectric Energy Harvesters. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-9288-2 2. Carvalho, C., Paulino, N. (2016). CMOS Indoor Light Energy Harvesting System for Wireless Sensing Applications. Springer, Cham. https://doi.org/10.1007/978-3-319-21617-1 3. Maurath, D., Manoli, Y. (2015). CMOS Circuits for Electromagnetic Vibration Transducers. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-9272-1 |
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