课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	**课程名称 Course Title**	电磁场与电磁波 Electromagnetic Field and Electromagnetic Wave
2.	**授课院系 Originating Department**	深港微电子学院 School of Microelectronics
3.	**课程编号 Course Code**	SME205
4.	**课程学分 Credit Value**	3
5.	**课程类别 Course Type**	专业基础课 Major Foundational Courses
6.	**授课学期 Semester**	春季 Spring / 秋季 Fall
7.	**授课语言 Teaching Language**	中英双语 English & Chinese
8.	**授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师） Instructor(s), Affiliation& Contact （For team teaching, please list all instructors）**	赵前程，助理教授，深港微电子学院，zhaoqc@sustech.edu.cn Qiancheng Zhao, assistant professor, School of Microelectronics, zhaoqc@sustech.edu.cn 李毅，副教授，深港微电子学院，liy37@sustech.edu.cn Yi Li, associate professor, School of Microelectronics, liy37@sustech.edu.cn
9.	**实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact**	助教 待公布 TA to be announced
10.	**选课人数限额(可不填) Maximum Enrolment （Optional）**	

11.	授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other（Please specify）	总学时 Total
	学时数 Credit Hours	48				48

12.	先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	MA101B 高等数学（上）A； MA103A 线性代数 I-A；EE104 电路基础
13.	后续课程、其它学习规划 Courses for which this course is a pre-requisite	本课程为微电子科学与工程以及集成电路专业的基础课程，是多门涉及电磁波传播与电磁能量转换，射频电路与高速集成电路，无线通信，光学等课程的先修课程。 This course is a fundamental course for students majored in Microelectronics Science and Engineering. It is a prerequisite course for subsequent classes on electromagnetic wave transmission, electromagnetic energy conversion, radio frequency circuits, high-speed circuits, wireless communications, photonics, etc.
14.	其它要求修读本课程的学系 Cross-listing Dept.	

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本课程介绍电磁场与电磁波的理论知识，包括静电场、静磁场、交变电磁场与电磁波、时谐波、波动方程的基本概念、原理和分析方法。系统讲解麦克斯韦方程组的物理含义和求解方法。运用麦克斯韦方程组和波动方程于具体应用中，包括偶极子、传输线、介质光波导等，深入理解抽象物理公式的实际意义。本课程采用国际经典教材，使用通用范式和符号表达，为后续课程打下基础，培养学生分析理解物理现象，简化求解过程的能力，帮助学生掌握数理工具，熟悉电磁波在无线传输、高速电路、光电子等应用的常见特征表现。

This course introduces the basic concepts and methodologies in electromagnetic field and electromagnetic wave, including static electric field, steady magnetic field, time-varying fields and Maxwell's Equations, time-harmonic fields, wave equations, etc. Applications such as transmission lines and optical fibers are covered to aid students further understanding the physical meanings behind the Maxwell's equations and wave equations. This course uses worldwide classic textbooks and handouts, and adopts conventional notations, with an objective to lay solid cornerstones for subsequent advanced courses. The broad aims of the course are to help student develop the capability to analyze electromagnetic phenomena and simplify problems, master mathematical tools and methodologies, and get familiar with electromagnetic characteristics in wireless transmission, high-speed circuits, photonics, etc.

16. 预达学习成果 Learning Outcomes

通过本课程的理论学习，学生能够：

1. 了解数学分析方法，包括矢量分析方法、球坐标系、柱坐标系等；
2. 掌握静电场的基本概念，包括：库伦定律、高斯定律、电势、拉普拉斯泊松方程、介质材料；
3. 掌握恒定磁场的基本概念，以及毕奥-萨伐尔定律、安培环路定律、磁场与磁通量密度、矢量势等；
4. 区分麦克斯韦方程组的微分和积分形式，和时谐波概念与波动方程，位移电流等概念；
5. 掌握平面波的基本概念，包括：坡印廷矢量、传输常数、阻抗、反射、折射、色散等概念；
6. 了解导波的基本应用：金属波导与传输线、光纤。

After completing the course, students are expected to:

1. Get familiar with useful mathematical analysis tools such as vector analysis and differential coordinates.
2. Master the basic concepts of static electric field, including Coulomb's law, Gauss' law, Laplace's and Poisson's Equation, dielectric material.
3. Master the basic concepts of steady magnetic field, including Biot-Savart's law, Ampere's circuital law, and Lorentz Law, magnetic field and magnetic flux density, vector potential.
4. Understand the Maxwell's Equations in differential and integral formats, understand the concepts of time-harmonic fields and wave equations, displacement current.;
5. Master the basic concepts of plane wave, including Poynting vector, propagation constant, impedance, reflection, refraction, dispersion, etc.
6. Get familiar with guided waves and their applications such as metal waveguides, transmission lines, and optic fibers.

17. 课程内容及教学日历 （如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）
Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

课程内容安排 Course syllabus

第 1 章：电磁场与电磁波数理基础：矢量分析方法，点乘、叉乘、梯度、旋度、散度；直角坐标、柱坐标系和球坐标系之间的转换（2 学时）

Lecture 1: Fundamentals of mathematical tools for solving electromagnetic problems: Vector Analysis including dot product, cross product, gradient, curl, divergence. Transforms in different coordinates such as Cartesian, cylinder, and sphere coordinates.

第 2 章：静态电场：从库仑定律出发学习电场强度和电通量密度；学习高斯定理、电势、线积分、静电场的能量守恒等概念；学习介质材料，介电常数、极化系数、拉普拉斯和泊松方程等。（8 学时）

Lecture 2: Static electric field: start from Coulomb's Law to derive electric field intensity and electric flux density. Study Gauss's Law and find electric potential, line integral, conservative property of the static electric field, Dielectric materials, permittivity, susceptibility, Laplace's and Poisson's Equation.

第 3 章：静态磁场：学习毕奥萨伐尔定律、安培环路定理、磁场强度、磁通量密度、磁导率等概念；学习磁场的高斯定理、磁势、矢势、磁性材料和磁化、磁场边界条件等（8 学时）

Lecture 3: Static current field and steady magnetic field: Biot-Savart Law, Ampere's circuital Law, magnetic field, magnetic flux, magnetic flux density, permeability, Gauss's Law for the magnetic field, magnetic potential, vector potential, magnetic material and magnetization, magnetic boundary condition

第 4 章：时变场和麦克斯韦方程：学习静态场的麦克斯韦方程组，引入时变场和位移电流的概念，学习法拉第定律、洛伦兹规范、时谐波以及波动方程（10 学时）

Lecture 4: Maxwell's Equations and time-varying fields: Maxwell's Equations for static fields, concept of the time-varying fields, displacement current, Faraday's Law, Lorentz Gauge, wave equations, time-harmonic waves

第 5 章：平面波：以波在真空中传播为例，扩展到在介质中传播，学习传播常数、坡印廷矢量、趋肤效应、阻抗、反射、透射、折射、驻波、和色散的概念（12 学时）

Lecture 5: Plane wave: wave in free-space, wave in dielectric, propagation constant, Poynting vector, skin effect, impedance, reflection, refraction, transmission, standing waves. dispersion.

第 6 章：电磁场电磁波应用：以理想传输线和光纤为例分析电磁波在金属波导和介质波导中的传输，利用特定的边界条件求解电磁波在波导中的分布和传播方式。（8 学时）

Lecture 6: Guided wave: ideal transmission lines and optical fiber. Solve the field distributions with certain boundary conditions

18. **教材及其它参考资料 Textbook and Supplementary Readings**

教材 Textbook： Engineering Electromagnetics，清华版双语教学用书(第 7 版)，William H. Hayt. Jr., John A. Buck，清华大学出版社，2008 参考书目 Reference： 1.Lecture Notes on ELECTROMAGNETIC FIELDS AND WAVES (227-0052-10L), Prof. Dr. Lukas Novotny, ETH Zurich 2.工程电磁场(第 8 版)，海特（Hayt,W.H.），[美] 巴克（Buck,J.A.） 著 赵彦珍，李程，孙晓华 译 马西奎 校，西安交通大学出版社，2011 3.Time-Harmonic Electromagnetic Fields, Roger F. Harrington, Wiley-IEEE Press, 2001

课程评估 ASSESSMENT

19.

评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance				
课堂表现 Class Performance		20		
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		30		
期中考试 Mid-Term Test				
期末考试 Final Exam		50		
期末报告 Final Presentation				
其它（可根据需要改写以上评估方式） Others (The above may be modified as necessary)				

20. **记分方式 GRADING SYSTEM**

■ A. 十三级等级制 **Letter Grading** ☐ B. 二级记分制（通过/不通过） **Pass/Fail Grading**

课程审批 REVIEW AND APPROVAL

21. **本课程设置已经过以下责任人/委员会审议通过**
This Course has been approved by the following person or committee of authority
