

## 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.	<b>课程名称 Course Title</b>	等离子体物理基础 Fundamentals of Plasma Physics
2.	<b>授课院系 Originating Department</b>	地球与空间科学系 Department of Earth and Space Sciences
3.	<b>课程编号 Course Code</b>	ESS314
4.	<b>课程学分 Credit Value</b>	4
5.	<b>课程类别 Course Type</b>	专业核心课 Major Core Courses
6.	<b>授课学期 Semester</b>	秋季 Fall
7.	<b>授课语言 Teaching Language</b>	中英双语 English & Chinese
8.	<b>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 &amp; Contact (For team teaching, please list all instructors)</b>	刘凯军, 地球与空间科学系 邮箱: liukj@sustech.edu.cn 电话: 0755-88018691 办公室: 创园 9 栋 409 Kaijun Liu, Department of Earth and Space Sciences Email: liukj@sustech.edu.cn Tel: 0755-88018691 Office: Innovation Park #9-409
9.	<b>实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact</b>	待公布 To be announced
10.	<b>选课人数限额(可不填) Maximum Enrolment (Optional)</b>	

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	64				64
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	PHY203-15 数学物理方法 PHY203-15 Mathematical Methods in Physics				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite					
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

本课程介绍等离子体物理学的基本知识，为后续空间物理专业课程的学习或未来从事等离子体物理相关研究工作奠定基础。

The course introduces the fundamentals of plasma physics to prepare students for future space physics courses and plasma-physics-related researches.

#### 16. 预达学习成果 Learning Outcomes

完成本课程后，学生应掌握以下知识：

1. 等离子体的定义及基本性质；
2. 带电粒子在电磁场中的轨道及运动特性；
3. 等离子体的流体力学描述；
4. 等离子体中各种波的基本性质；
5. 等离子体的平衡态的含义及各种不稳定性；
6. 等离子体的动力学描述以及与流体力学描述的关系；
7. 等离子体中的一些非线性效应。

Upon completing the course, students will:

1. know the definition and basic characteristics of plasma;
2. be familiar with the motions of a single charged particle in magnetic and electric fields;
3. understand magnetohydrodynamics, the fluid description of plasma;
4. know various plasma waves and their different properties;
5. know the meaning of plasma equilibrium and understand some key plasma instabilities;
6. understand kinetic plasma theory and its connection with magnetohydrodynamics;
7. know basics about some nonlinear plasma effects.

#### 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.)**

**第一章：介绍（4学时）**

介绍等离子体物理的定义及基本性质。

**第二章：单粒子轨道理论（12学时）**

学习带电粒子在典型磁场和电场作用下的运动轨迹。

**第三章：磁流体理论(8学时)**

讨论等离子体的流体力学描述。

**第四章：等离子体波(12学时)**

介绍等离子体中各种波的色散关系、不同名称及性质。

**第五章：等离子体扩散和电阻(4学时)**

讲述等离子体的扩散及由粒子碰撞产生的等离子体电阻。

**第六章：等离子体不稳定性(8学时)**

介绍等离子体的平衡态及典型的等离子体不稳定性。

**第七章：动力学理论（12学时）**

学习等离子体的动力学描述，包括波尔兹曼方程、弗拉索夫方程以及动力学理论与磁流体理论间的关系。

**第八章：非线性效应（4学时）**

简单介绍等离子体中的一些非线性效应。

**Chapter 1: Introduction (4 hours)**

This section introduces the definition and basic characteristics of plasma.

**Chapter 2: Single particle motions (12 hours)**

This section discusses the motion of a single charged particle in background magnetic and electric fields.

**Chapter 3: Magnetohydrodynamics (8 hours)**

This section introduces the basic magnetohydrodynamics equations which describe plasma as an ionized fluid.

**Chapter 4: Plasma waves (12 hours)**

This section covers plasma waves: their dispersion relations and different properties.

**Chapter 5: Diffusion and Resistivity (4 hours)**

This section addresses the diffusion in plasmas and plasma resistivity due to particle collision

**Chapter 6: Plasma equilibrium and instability (8 hours)**

This section discusses the concept of plasma equilibrium and instability. It will also introduce several typical instabilities in plasmas.

**Chapter 7: Kinetic theory (12 hours)**

This section introduces the kinetic plasma description, including Boltzmann equation, Vlasov equation, and their connection with magnetohydrodynamics.

**Chapter 8: Nonlinear effects (4 hours)**

This section briefly introduces some nonlinear effects in plasma physics.

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

Introduction to Plasma Physics and Controlled Fusion, Francis F Chen, Springer US, 2nd or 3rd Edition.

**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				
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		30		
期中考试 Mid-Term Test		30		
期末考试 Final Exam		40		
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

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