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**	地球物理学基础 II（地磁地电地热和重力） Fundamentals of Geophysics II (Geomagnetism, Geoelectricity, Geothermics and Gravity)
2.	**授课院系 Originating Department**	地球与空间科学系 Department of Earth and Space Sciences
3.	**课程编号 Course Code**	ESS309
4.	**课程学分 Credit Value**	4
5.	**课程类别 Course Type**	专业核心课 Major Core Courses
6.	**授课学期 Semester**	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）**	任恒鑫，地球与空间科学系 邮箱：renhx@sustech.edu.cn 电话：0755-88018799 办公室：创园 9 栋 309 Hengxin Ren, Department of Earth and Space Sciences Email: renhxd@sustech.edu.cn Tel: 0755-88018799 Office: Innovation Park #9-309
9.	**实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact**	待公布 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	64				64

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	MA101B 高等数学（上）A MA101B Calculus I A
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

本课程介绍地磁学、地电学、地热学和重力学的基本原理、研究方法和应用，使学生了解相关的基本概念，为后续专业课程的学习和相关研究工作的开展打下基础。

This course introduces fundamental principles of Geomagnetism, Geoelectricity, Geothermics and Gravity, including their theories, methods, and applications. This course will help students understand the related basic concepts, and provides the basics for subsequent studies of major courses and further researches.

16. 预达学习成果 Learning Outcomes

学生完成本课程后，将会掌握以下知识：

1. 地磁场的构成，Gauss 球谐分析，地磁场的主要特征，古地磁学的基本概念；
2. 大地电场的一般特征，电阻率法和大地电磁测深法的基本原理；
3. 热传导方程，地球内部的热源、温度分布，地热资源；
4. 重力学的基本概念、原理和应用。

Upon completing the course, students will master the following knowledge:

1. Constitution of geomagnetic field, Gauss spherical harmonic analysis, main characteristics of geomagnetic field and basic conceptions of paleomagnetism;
2. General characteristics of geoelectric field and fundamentals of resistivity method and magnetotelluric sounding method
3. Heat conduction equation, Earth interior's heat source and temperature distribution, and geothermal resources
4. Basic conceptions, theory and applications of gravity.

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（1 学时）

地球物理学的研究历史、研究现状和研究意义。

第二章：地磁场结构（3 学时）

地磁要素，地磁场构成，地磁图。

第三章：地球基本磁场（8 学时）

高斯球谐分析，地磁坐标，长期变化，西向漂移，地磁场起源。

第四章：地球变化磁场（2 学时）

太阳静日变化，太阴日变化，磁暴，极光区磁扰，地磁脉动。

第五章：古地磁学（4 学时）

岩石的剩余磁性、古地磁学原理、方法和应用。

第六章：地电场（4 学时）

大地电场的一般特征、分类和变化，自然电场。

第七章：有源直流电场（6 学时）

岩石和矿物的电阻率，电阻率法的基本原理，电阻率测深法，电阻率剖面法。

第八章：大地电磁测深（6 学时）

大地电磁测深法原理，大地电磁测深资料的解释，大地电磁测深法的应用。

第九章：频率域和时间域电磁测深（2 学时）

频率域电磁测深，瞬变时间域电磁测深。

第十章：地球的重力场（4 学时）

重力场和重力位，正常重力场，重力校正，重力异常。

第十一章：重力异常场的正反演和划分（4 学时）

几种规则均匀密度异常体的重力异常正反演，二维均匀水平柱体的正反演，局部重力异常，区域重力异常。

第十二章：重力测量（4 学时）

绝对重力测量，相对重力测量，微重力测量。

第十三章：重力资料的解释和应用（2 学时）

重力资料在研究地壳深部构造、地壳均衡和地震预报中的应用。

第十四章：固体潮（4 学时）

固体潮现象，起潮力，重力固体潮，地倾斜固体潮，勒夫数，潮汐因子。

第十五章：热传递和地球内部热源（2 学时）

温度场，热传导方程，地球形成时的能量，放射性元素产生的热能，地球的旋转能及其它能量。

第十六章：热传输机制和大地热流密度（4 学时）

金属电子导热，热辐射，物质迁移，热流密度的区域变化，地面热流密度。

第十七章：地球内部的温度分布和地热能（4 学时）

地壳、地幔和地核的温度，地热系统的类型，中国的地热资源。

Chapter 1: Introduction(1 hour)

This section gives an introduction on research history, research status and research significance of geophysics.

Chapter 2: The structure of geomagnetic field (3 hours)

This section introduces geomagnetic elements, the constitution of geomagnetic field and geomagnetic map.

Chapter 3: Geomagnetic main field (8 hours)

This section introduces Gauss spherical harmonic analysis, geomagnetic coordinates, secular variation, westward drift and geomagnetic field field’s origin.

Chapter 4: Varying geomagnetic field (2 hours)

This section introduces solar quiet daily variation, lunar daily variation, magnetic storm, magnetic disturbance in aurora zone and geomagnetic pulsation.

Chapter 5: Paleomagnetism (4 hours)

This section introduces residual magnetism of the rock as well as the principal, method and application of paleomagnetism.

Chapter 6: Geoelectric field (4 hours)

This section introduces general characteristics, classification and variations of geoelectric field in addition to self-potential.

Chapter 7: Active direct-current electric field (6 hours)

This section introduces electric resistivity of rock and mineral, fundamental of resistivity method, resistivity sounding method and resistivity profiling method.

Chapter 8: Magnetotelluric sounding (6 hours)

This section introduces theory and application of magnetotelluric sounding method as well as interpretation of magnetotelluric sounding data.

Chapter 9: Frequency-domain and time-domain electromagnetic sounding (2 hours)

This section introduces frequency-domain electromagnetic sounding method and transient time-domain electromagnetic sounding method.

Chapter 10: Earth gravity (4 hours)

This section introduces gravity field and gravity potential, normal gravity field, gravity

correction and gravity anomaly.

Chapter 11: Gravity anomalous field's forward and inversion & partition (4 hours)

This section introduces gravity anomalous field's forward and inversion for several regular and homogeneous density anomaly, forward and inversion for 2D homogeneous horizontal cylinder, local gravity anomaly and regional gravity anomaly.

Chapter 12: Gravity measurement (4 hours)

This section introduces the measurement of absolute gravity, relative gravity and microgravity.

Chapter 13: Interpretation and application of gravity data (2 hours)

This section introduces the applications of gravity data in studies of deep Earth crust structure, isostasy and earthquake prediction.

Chapter 14: Earth tide (4 hours)

This section introduces earth tide phenomenon, tide producing force, gravity tide, ground tilt tide, Love's number and tidal factor.

Chapter 15: Heat conduction and Earth interior heat resources (2 hours)

This section introduces temperature field, heat conduction equation, heat energy originated from Earth's formation, radioactive element, Earth rational energy and other energies.

Chapter 16: Heat transfer mechanism and terrestrial heat flow density (4 hours)

This section introduces metal electron's heat conduction, thermal radiation, material migration, regional variation of heat flow density and ground heat flow density.

Chapter 17: Earth interior temperature distribution & geothermal energy (4 hours)

This section introduces the temperature of Earth crust, Earth mantle and Earth core, type of geothermal system and Chinese geothermal resources.

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

1. Michael S. Zhdanov, Foundations of Geophysical Electromagnetic Theory and Methods, Elsevier Press, Netherlands;
2. 徐文耀，2009，地球电磁现象物理学，中国科学技术大学出版社；
3. 李金铭，2005，地电场与电法勘探，地质出版社；
4. 史謌，2002，地球物理学基础，北京大学出版社。

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		10		

课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		20		
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