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**	地球物理仪器基本工作原理及应用 Basic Principles and Applications of Geophysical Instruments
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**	ESS324
4.	**课程学分 Credit Value**	2
5.	**课程类别** **Course Type**	专业选修课 Major Elective Courses
6.	**授课学期** **Semester**	春季 Spring
7.	**授课语言** **Teaching Language**	中文 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）**	李波，地球与空间科学系 邮箱：lib9@sustech.edu.cn 电话：0755-88018861 办公室：理学院 E2140 Bo Li, Department of Earth and Space Sciences Email: Lib9@sustech.edu.cn Tel: 0755-88018861 Office: College of Science Building E2140
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	无 NA				
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

通过本课程实践教学，要求学生了解常用地球物理仪器的基本工作原理，掌握常用地球物理仪器的应用领域和操作规范流程，野外数据的初步分析和评价等内容。培养学生具有地球物理工作方案的设计和野外数据采集的能力，具备原始数据的定性分析和质量评价的能力，为进一步学习地球物理课程、开展地球物理研究打下基础。

Through the practical teaching of this course, students are required to understand the basic working principles of common geophysical instruments, master the application fields and operation procedures of common geophysical instruments, and conduct preliminary analysis and evaluation of field data. Students are trained to be able to design geophysical work programs and collect field data, as well as to be capable of qualitative analysis and quality evaluation of raw data, which lays a foundation for further study of geophysical courses and geophysical researches.

16. 预达学习成果 Learning Outcomes

学生完成本课程后，将会掌握以下知识和技能：

1. 了解常用地球物理仪器的基本工作原理
2. 熟悉地球物理野外工作的方案设计
3. 掌握常用地球物理仪器的应用范围、操作流程和注意事项
4. 掌握地球物理野外原始数据的定性分析和质量评价的技能

Upon completing the course, students will acquire the following knowledge and skills:

1. Understand the basic working principles of commonly used geophysical instruments
2. Familiar with the scheme design of geophysical field work
3. Master the application fields, operating procedures, and cautions of commonly used geophysical instruments
4. Master the skills of qualitative analysis and quality evaluation of geophysical field raw data

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：课程简介（4 实验学时）

实验一：课程简介及常用地球物理仪器认知实验（4 实验学时）

1. 课程概况介绍

2. 介绍课程所使用的各种地球物理仪器（地震仪、电法仪、地质雷达、重力仪、磁力仪等）

3. 介绍实验报告编写要求及规范

第二章：天然源地震仪观测实验（20 实验学时）

实验二：宽频带地震仪观测实验（4 实验学时）

1. 介绍宽频带地震仪的组成，基本工作原理，适用领域

2. 讲解宽频带地震仪仪器连接、参数配置及使用注意事项

3. 运用宽频带地震仪进行数据采集

实验三：短周期地震仪观测实验（8 实验学时）

1. 介绍短周期地震仪的基本工作原理，适用领域

2. 讲解短周期地震仪的参数配置，野外布设及使用注意事项

3. 利用两种不同型号短周期地震仪进行数据采集

实验四：4G 节点式地震仪观测实验（4 实验学时）

1. 介绍 4G 节点地震仪的组成，基本工作原理，适用领域

2. 讲解 4G 节点地震仪的部件连接、参数配置及使用注意事项

3. 运用 4G 节点式地震仪进行数据采集并实时观察各种震动波形特征

实验五：天然地震原始数据初步分析（4 实验学时）

1. 讲解各种地震仪原始记录数据的导出和存储

2. 利用相关软件对野外数据进行成图

3. 通过波形图对野外原始数据进行初步分析并对数据记录质量进行评价

第三章：人工源地震仪观测实验（12 实验学时）

实验六：工程地震仪观测实验（4 实验学时）

1. 介绍工程地震仪的组成部分，基本工作原理，适用领域

2. 讲解工程地震仪各组成部分的连接，参数设置及使用注意事项

3. 采用合适的观测系统进行人工源地震数据采集

实验七：节点检波器观测实验（4 实验学时）

1. 介绍节点检波器的组成部分，基本工作原理，适用领域

2. 讲解节点检波器的野外布置方式，参数设置及使用注意事项

3. 运用节点式检波器进行人工源地震数据采集

实验八：人工源地震野外数据初步分析（4 实验学时）

1. 讲解工程地震仪和节点检波器原始记录数据的导出和存储

2. 整理野外原始记录数据，利用绘图软件对野外数据进行成图，初步分析波形记录并对数据记录质量进行评价。

3. 利用数据分析软件对折射波法地震数据进行初步处理，分析地下浅层速度结构。

第四章：电法仪及探地雷达观测实验（12 实验学时）

实验九：高密度直流电法观测实验（4 学时）

1. 介绍高密度直流电法仪器的组成部分，基本工作原理，适用领域
2. 讲解高密度直流电法仪的野外布设方式，相关采集参数设置及使用注意事项
3. 分别进行温纳装置、斯隆贝格、偶极等装置的野外数据采集工作

实验十：探地雷达观测实验（4 实验学时）

1. 介绍探地雷达仪器的组成部分，基本工作原理，适用领域
2. 讲解探地雷达各组成部分的连接，参数设置及使用注意事项
3. 分别用低频天线和高频天线进行探地雷达野外数据采集工作

实验十一：高密度直流电法和探地雷达原始数据初步分析（4 实验学时）

1. 高密度直流电法和探地雷达原始数据导出和存储
2. 利用高密度数据处理软件对原始数据进行初步分析并对数据质量进行评价
3. 利用探地雷达数据处理软件对原始数据进行分析并对数据质量进行评价

第五章：重力仪、磁力仪观测实验（12 实验学时）

实验十二：重力仪观测实验（4 实验学时）

1. 介绍重力仪的基本工作原理，适用领域
2. 讲解重力仪的野外观测布置方式，参数设置及使用注意事项
3. 利用重力仪进行数据采集

实验十三：磁力仪观测实验（4 实验学时）

1. 介绍磁力仪的基本工作原理，适用领域
2. 讲解磁力仪的野外观测布置方式，参数设置及使用注意事项
3. 利用磁力仪进行野外数据采集

实验十四：重力仪、磁法仪器观测原始数据初步分析（4 实验学时）

1. 介绍重力仪、磁力仪野外原始数据导出和存储
2. 利用成图软件对原始数据进行成图分析

第六章：指导实验报告编写（4 实验学时）

实验十五：指导实验报告编写（4 实验学时）

1. 指导学生完成实验报告编写工作

Chapter 1: Course Introduction (4 Experimental Hours)

Experiment 1: Course Introduction and Cognition of Commonly Used Geophysical Instruments

1. Course Overview Introduction

2. The introduction of various geophysical instruments used in the course (seismometers, electrical instruments, ground penetrating radar, gravimeters, magnetometers, etc.)

3. Introduction to the requirements and specifications for writing experimental reports

Chapter 2: Data Acquisition of Natural Source Seismometers (20 Experimental Hours)

Experiment 2: Data Acquisition of Broadband Seismometers (4 experimental hours)

1. Introducing the composition, basic working principles, and applicable fields of broadband seismometers

2. Explaining the connection, parameter configuration, and application notices of broadband s seismometers

3. Using a broadband seismograph for data acquisition

Experiment 3: Data Acquisition of Short Period Seismometers (8 experimental hours)

1. Introducing the basic working principle and applicable fields of short period seismometers

2. Explaining the parameter configuration, field deployment, and application notices of short period seismometers

3. Using two different models of short period seismometers for data acquisition

Experiment 4: Data Acquisition of 4G Node Seismometers (4 experimental hours)

1. Introducing the composition, basic working principles, and applicable fields of 4G node seismometers

2. Explaining the component connections, parameter configurations, and application notices of 4G node seismometers

3. Using 4G node seismometers for data collection and real-time observation of various seismic waveform characteristics

Experiment 5: Preliminary Analysis of The Natural Earthquake Raw Data (4 Experimental Hours)

1. Explaining the export and storage of raw recorded data from various seismometers

2. Using relevant software to map field data

3. Conducting preliminary analysis of field raw data through waveform diagrams and evaluating the quality of data recording

Chapter 3: Data Acquisition of Artificial Source Seismometers (12 Experimental Hours)

Experiment 6: Data Acquisition of The Engineering Seismometer (4 experimental hours)

1. Introducing the components, basic working principles, and applicable fields of the engineering seismometer

2. Explaining the connections, parameter settings, and application notices of the engineering seismometer

3. Using appropriate observation systems for artificial seismic data collection

Experiment 7: Data Collection of Node Geophones (4 experimental hours)

1. Introducing the components, basic working principles, and applicable fields of node geophones

2. Explaining the field layout, parameter settings, and application notices of node geophones

3. Using node geophones for artificial source seismic data collection

Experiment 8: Preliminary Analysis of The Artificial Source Earthquake Field Data (4 Experimental Hours)

1. Explaining the export and storage of raw recorded data collected by engineering seismometers and node geophones

2. Organizing the raw field record data, using mapping software to map the field data, preliminarily analyzing waveform records, and evaluating the quality of data records.

3. Using data analysis software to perform preliminary processing on refracted wave seismic data and analyzing the velocity structure of the shallow underground layer.

Chapter 4: Data Acquisition of Electrical Instrument and Ground Penetrating Radar (12 Experimental Hours)

Experiment 9: High density direct current method data acquisition (4 class hours)

1. Introducing the components, basic working principles, and applicable fields of high-density DC electrical instruments

2. Explaining the field deployment method, parameter settings, and application notices of the high-density DC electrical meter

3. Conducting field data collection for Wenner device, Slonberg device, dipole device, etc

Experiment 10: Ground Penetrating Radar Data Collection (4 experimental hours)

1. Introducing the components, basic working principles, and applicable fields of the ground penetrating radar

2. Explaining the connections, parameter settings, and application notices of the ground penetrating radar

3. Using low-frequency and high-frequency antennas respectively for ground penetrating radar field data collection work

Experiment 11: Preliminary Analysis of High Density Direct Current Method Raw Data and GPR Raw Data (4 Experimental Hours)

1. Export and storage of raw data from high-density direct current method and ground penetrating radar

2. Using high-density data processing software to conduct preliminary analysis of the raw data and evaluate the data quality

3. Using ground penetrating radar data processing software to analyze the raw data and evaluate the data quality

Chapter 5: Data Collection of Gravimeter and Magnetometer (12 experimental hours)

Experiment 12: Gravimeter Data Collection (4 experimental hours)

1. Introducing the basic working principle and applicable fields of a gravimeter
2. Explaining the field observation layout, parameter settings, and appicaton notices of the gravimeter
3. Using a gravimeter for data collection

Experiment 13: Magnetometer Data Collection (4 experimental hours)

1. Introducing the basic working principle and applicable fields of a magnetometer
2. Explaining the field observation layout, parameter settings, and application notices of the magnetometer
3. Using a magnetometer for field data collection

Experiment 14: Preliminary Analysis of Raw Data Collected by Gravimeters and Magnetometers (4 Experimental Hours)

1. Introduction to the export and storage of field raw data from gravimeters and magnetometers
2. Using mapping software to perform mapping analysis on raw data

Chapter 6: Guidelines for Writing Experimental Reports (4 Experimental Hours)

Experiment 15: Guidelines for Writing Experimental Reports (4 Experimental Hours)

1. Guiding students to complete the writing of experimental reports

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

1. 地震学、震源及地球结构概论，科学出版社，[美]塞思.斯坦、迈克尔威瑟逊著，梁春涛等译，2020 年。
2. 地震勘探原理，石油大学出版社，陆基孟，2005 年。
3. 重磁勘探原理与方法，科学出版社，李才明、李军，2013 年。
4. 电法勘探基本原理与方法，地质出版社，刘国兴，2005 年。
5. 探地雷达理论与应用，电子工业出版社，[美]乔尔著，雷文太等译，2011 年。
6. 工程与环境物探教程，地质出版社，陈仲候等，1999 年。
7. 应用地球物理教程，地质出版社，傅良魁，1990 年。

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		20		
课堂表现 Class Performance		20		
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments				
期中考试 Mid-Term Test				
期末考试				

Final Exam				
期末报告 Final Presentation		60		
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

地球与空间科学系本科教学指导委员会 Undergraduate Teaching Steering Committee of the Department of Earth and Space Sciences