

## 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>	空间大地测量 Space Geodetics
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>	ESS407
4.	<b>课程学分 Credit Value</b>	2
5.	<b>课程类别 Course Type</b>	专业选修课 Major Elective Courses
6.	<b>授课学期 Semester</b>	夏季 Summer
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>	陈武, 香港理工大学 邮箱: wu.chen@polyu.edu.hk Wu Chen, Hong Kong Polytechnic University Email: wu.chen@polyu.edu.hk
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	习题/辅导/讨论	实验/实习	其它(请具体注明)	总学时
	Lectures	Tutorials	Lab/Practical	Other (Please specify)	Total
学时数 Credit Hours	30			2 (考试)	32
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements					
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

该课程主要介绍目前广泛应用的新型空间大地测量方法和原理。主要内容包括：大地测量的基本概念，空间参考系及相互关系、卫星轨道运动、GPS 原理及大地测量方法、激光测距原理、卫星测高原理、重力场卫星观测原理和 InSAR 形变测量原理等。通过本课程的学习，使学生了解以现代空间大地测量技术以及地球科学研究中的应用，拓宽级本科生的知识面。

This course mainly introduces the principles and methods of modern space geodesy. The main contents include: the basic concepts of geodesy, spatial reference systems and their correlations, satellite orbital motion, GPS principles and geodetic methods, laser ranging principle, satellite altimetry principle, gravity field satellite observation principle and InSAR deformation measurement principle. Through this course of study, students can understand the application of modern space geodesy technology in Earth sciences.

#### 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. 空间大地测量的时间系统和坐标系统；
  2. 全球卫星导航定位系统的原理和方法；
  3. 激光测距的原理、系统和定轨；
  4. 卫星测高原理、基准和误差分析；
  5. 重力场观测原理、观测数据精化和应用；
  6. 合成孔径雷达干涉测量形变监测原理。

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

1. Space geodetic time systems and coordinate systems;
2. The principles and methods of global satellite navigation and positioning system;
3. The principles and system of laser ranging along with precision orbit determination;
4. The principles, benchmark and error analysis of satellite altimetry;
5. The principles of gravity field observation, gravity data refinement and its application;
6. The principles of Interferometric Synthetic Aperture Radar (InSAR).

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.)**

**引言：课程概述（2 学时）**

介绍大地测量学科分类、发展历程（地球圆球阶段、地球椭球阶段、大地水准面阶段、现代大地测量新时期）、卫星大地测量在地球科学体系中应用以及本课程的主要内容。

**第一章：地球坐标系统与坐标转换（4 学时）**

介绍空间大地测量学中的空间参考系、岁差和章动、空间大地测量坐标系之间的转换。

**第二章：卫星轨道（4 学时）**

回顾二体运动理论（开普勒运动三定律、牛顿二体问题）、卫星摄动，卫星轨道计算原理。

**第三章：GNSS 大地测量原理（8 学时）**

第一次课（2 学时）：GPS 系统及其发展。

第二次课（2 学时）：GNSS 信号结构和测量观测量，GNSS 主要误差。

第三次课（2 学时）：GNSS 伪距定位方法。

第四次课（2 学时）：GNSS 载波相位定位方法，高精度 GNSS 定位的应用。

**第四章：地球重力场和高程系统（6 学时）**

地球重力场，大地水准面，大地测量高程系统。

**第五章：其他空间大地测量技术简介（6 学时）**

卫星重力测量，卫星激光测距，INSAR，VLBI 等现代大地测量技术原理及应用。

**考试（2 学时）**

**Introduction: Course Overview (2 hours)**

Introduce the classification and development of geodesy (sphere stage, ellipsoid stage, geoid stage, modern geodetic survey), application of satellite geodesy in Earth science, and the main contents of this course.

**Chapter 1: Earth Coordinate System and Coordinate Transformation (4 hours)**

Introduce the transformation between spatial reference system, precession and nutation, spatial geodetic coordinate system transformation.

**Chapter 2: Satellite Orbits (4 hours)**

A review of the theory of the second body movement (Kepler's Three Laws, Newton's Two-body Problem), satellite perturbation, and the calculation of satellite orbit.

**Chapter 3: Principles of GNSS Geodetic Survey (8 hours)**

The 1st class (2 hours): GPS system and its development.

The 2nd class (2 hours): The signal structure, measurement, and major error sources of GNSS.

The 3rd class (2 hours): GNSS pseudorange positioning method

The 4th class (2 hours): GNSS carrier phase positioning method, and high precision GNSS positioning application.

**Chapter 4: Earth's Gravity Field and Elevation System (6 hours)**

The Earth's gravity field, geoid, geodetic elevation system.

**Chapter 5: Other Spatial Geodetic Techniques (6 hours)**

The principles and applications of modern geodetic techniques such as satellite gravity measurement, satellite laser ranging, INSAR, and VLBI.

**Examination (2 hours)**

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

1. Günter Seeber, Satellite geodesy: Foundations, methods, and applications, Walter de Gruyter GmbH, New York, 2003.
2. William M. Kaula, Theory of satellite geodesy: Applications of satellites to geodesy, Blaisdell Publishing company, 1996.
3. Xu Guochang, GPS Theory, Algorithms and Applications, Springer, 2007.
4. Xu Guochang, Orbits, Springer, 2008.
5. 王超、张红、刘智, 星载合成孔径雷达干涉测量, 科学出版社, 2002.
6. 孔祥元, 郭际明, 刘宗泉, 大地测量学基础, 武汉大学出版社, 2006.
7. 李天文, GPS 原理及应用, 科学出版社, 2003.
8. 魏二虎、黄劲松, GPS 测量操作与数据处理, 武汉大学出版社, 2004.

**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				
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

