课程大纲
COURSE SYLLABUS

1.	**课程代码/名称 Course Code/Title**	**ESS5056/现代大地测量技术 Modern Geodesy**
2.	**课程性质 Compulsory/Elective**	专业选修课/ **Elective**
3.	**课程学分/学时 Course Credit/Hours**	3/48
4.	**授课语言 Teaching Language**	中英文/ English & Chinese
5.	**授课教师 Instructor(s)**	冉将军/ Jiangjun Ran
6.	**先修要求 Pre-requisites**	本课程针对理工科研究生所开设，需要具备微积分和线性代数等数理基础，并具备计算机编程基础。The course is designed for graduate students in Science and Engineering. Calculus, Linear Algebra and basic knowledge of programming are pre-requisites for this course.

7. 教学目标 Course Objectives

学生完成本课程后，将会掌握以下知识：

1. 掌握关于现代大地测量技术的基本原理和方法，涵盖全球卫星定位系统（包括北斗、GPS、GLONASS 和 Galileo 等）、卫星重力、卫星测高和合成孔径雷达干涉测量(InSAR)等；
2. 具备应用现代大地测量观测数据解释相应地球物理信号（如，同震位移、地壳形变、质量迁移、冰川融化等）的能力；
3. 通过作业和口头报告学习如何开展现代大地测量方面的研究。

Upon completing the course, students will:

1. Master the basic theory and methods of modern geodesy, including the Global Navigation Satellite System (GNSS, i.e., BeiDou, GPS, GLONASS, and Galileo), Satellite Gravimetry, Satellite Altimetry, and Interferometric Synthetic Aperture Radar (InSAR).

2. Be capable of using modern geodetic observation data to interpret corresponding geophysical signals (e.g., co-seismic displacement, crustal deformation, mass migration, glacier melting, etc.).

3. Learn how to research modern geodesy through homework and oral presentations.

8. 教学方法 Teaching Methods

本课程将以课堂讲授为主，并结合课堂作业、仪器操作和期末报告等形式组成。
The course will compose lectures, complemented with homework, experiment, and final presentation.

9. 教学内容 Course Contents

Section 1	**现代空间大地测量技术介绍（2 学时）** 介绍现代大地测量技术的研究内容、目标和考核方式。 **Introduction of modern space geodesy (2 hours)** Introduction to the Modern Geodetic course, including contents, goals, and assessment.
Section 2	**全球卫星定位系统（15 学时）** 介绍全球卫星定位系统（主要以北斗和 GPS 为例）的基本原理和方法。重点介绍高精度定位的具体实现方法，如精密单点定位、差分相对定位等。讲授利用高精度

	GNSS 接收机的数据采集和处理。 **Global Navigation Satellite System (15 hours)** This section introduces the basic principles and methods of the Global Navigation Satellite System (e.g., Beidou and GPS). Then, the specific methods of positioning, such as precise point positioning and Differential GPS, are discussed. Finally, this section also covers data acquisition and processing using a high-precision GNSS receiver.
Section 3	**卫星重力的原理（18 学时）** 介绍地球重力场的基本概念以及解算地球重力场模型的基本方法。重点讲授不同模式的卫星重力原理（高-低跟踪模式、低-低跟踪模式和重力梯度模式）。以 GRACE（低低跟踪模式）为例，详细介绍其原理和数据处理方法。 **Principle of satellite gravity (18 hours)** This section introduces the basic concept of the Earth gravitational field and the basic methods for estimating the earth gravitational field. Then, this section focuses on the principle of satellite gravity in different modes (e.g., Satellite-to-Satellite Tracking in the High-Low Mode, Satellite-to-Satellite Tracking in the Low-Low Mode and Satellite Gravity Gradiometry).Taking GRACE (low and low tracking mode) as an example, its principle and data processing method are introduced in detail.
Section 4	**卫星测高（6 学时）** 介绍卫星测高的基本原理和方法。以湖泊、青藏高原冰川、格陵兰冰盖为例，重点介绍卫星测高的具体数据处理方法和解译。 **Satellite Altimetry (6 hours)** The basic principle and method of satellite altimetry will be introduced in this section. By taking lakes, glaciers on the Tibet Plateau and Greenland ice sheet as examples, the data processing methods and interpretation of satellite altimetry will be discussed.
Section 5	**合成孔径雷达干涉测量（4 学时）** 介绍合成孔径雷达干涉测量(InSAR)的基本理论和方法。以地表形变、冰川流速为例，介绍其在地球物理学领域的具体应用。 **Interferometric Synthetic Aperture Radar (4 hours)** This section introduces the basic theory and method of InSAR, and discusses its application in geophysics by taking surface deformation and glacier velocity as examples.
Section 6	**综合现代大地测量技术的地球科学应用 （3 学时）** 综合全球定位系统、卫星重力、卫星测高和合成孔径雷达干涉等现代大地测量技术，介绍其在地球科学领域的应用。 **Application by combining different modern geodetic techniques (3 hours)** This chapter combines different modern geodetic technologies such as global positioning

	system, satellite gravity, satellite altimetry and synthetic aperture radar interferometry, and introduces their applications in Geoscience.

10. 课程考核 Course Assessment

出勤5%+作业35%+期末报告60%
Attendance 5%, homework 35%, final paper and presentation 60%

11. 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.