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2022 级测绘工程专业本科培养方案

一、专业基本信息

英文名称	Surveying and Mapping Engineering		
专业代码	081201	学科门类	工学
学　　制	4 年	授予学位	工学学士

二、培养目标和专业特色

1.培养目标

培养德、智、体、美、劳全面发展，掌握测绘工程基础理论、基本知识和基本技能，接受科学思维和工程实践训练，具有人文素养、职业道德和社会责任感，胜任国家基础测绘、城乡建设、自然资源监测、地理信息服务及应急管理等领域测绘项目的设计、生产、研发及管理工作，具有较强的组织管理能力、创新意识、继续学习能力、国际视野和城市测绘特色的应用型工程技术人才。

毕业后经过 5 年左右的工作和学习，能够达到如下目标:

（1）能在国家基础测绘、城乡建设、地理信息服务及应急管理等领域胜任工程勘测、设计、施工及管理等方面的测绘技术工作；

（2）具有良好专业素养、丰富的工程管理经验和极强工作责任心，成为测绘地理信息企事业单位中的技术负责人或技术骨干；

（3）具有继续学习适应发展的能力，能够独立或协同承担测绘地理信息科研工作；

（4）具有良好的团队意识、国际化视野和沟通能力，能在设计、生产、研发和多学科团队中担任组织管理骨干或技术负责人角色，具备团队协作精神及领导力；

（5）具有良好的思想道德修养和科学文化素养，具有社会责任感、事业心及良好的职业道德，能够承担和履行社会责任，服务于国家与社会。

2.专业特色

本专业依托首都建设和学校土木建筑类学科优势，培养服务首都、面向全国、依托建筑行业、服务城乡建设的专业测绘人才。人才培养适应测绘高新科技发展，融教学、科研和生产为一体，强调理论与实践密切结合，培养测绘新技术、新方法、新工艺的应用能力，突出城市测绘特色，满足城乡建设、古建筑保护、复杂结构精密测量等测绘人才需求。

三、主干学科

测绘科学与技术

四、主干课程

1．主干基础课程

测绘地理信息概论、工程制图与识图、C 语言程序设计、数据结构、地球科学概论、数字地形测量学、地图学、CAD 基础与应用、误差理论与测量平差基础、大地测量学基础、地理信息系统原理（双语）、遥感原理与应用、摄影测量学。

2．主干专业课程

GNSS 原理及其应用、工程测量学、变形监测与灾害预报、不动产测量与管理、激光雷达测量技术与应用。

五、主要实践教学环节

1．主要实验

数字地形测量学实验 、卫星导航定位技术实验 、摄影测量实验、地理信息系统原理实验、大地测量学基础实验、工程测量学实验、变形监测实验、不动产测量与管理实验、激光雷达测量技术实验。

2．主要实践环节

数字地形测量实习、卫星导航定位实习、遥感原理实习、摄影测量实习、地理信息系统实习、地图学实习、控制测量实习、自然地理地貌及遥感图像解译实习、工程测量综合实习、空间信息综合实习、不动产测量与管理实习、激光雷达测量实习。

六、毕业学分要求

参照北京建筑大学本科学生学业修读管理规定及学士学位授予细则，修满本专业最低计划学分应达到 173 学分，其中理论课程 133 学分，实践教学环节 40 学分（含创新实践及科研训练必修 2 学分）。

七、各类课程结构比例

课程类别	课程属性	学分	学时	学分比例
通识教育课	必修	43.5	736	25.14%
	选修	2	32	1.16%
大类基础课	必修	43	756	24.86%
	选修	1	16	0.58%
专业核心课	必修	16	256	9.25%
专业方向课	必修	7	112	4.05%
	选修	20.5	328	11.85%
独立实践环节	必修	38	872	21.97%
	选修	2	40	1.16%
总计		173	3148	100%

八、教学进程表

学期	教学周	考试	实践	学期	教学周	考试	实践
1	4-19 周	20 周	1-3 周	2	1-16 周	17 周	18-20 周
3	1-15 周	16 周	17-20 周	4	1-16 周	17 周	18-20 周
5	1-16 周	17-18 周	19-20 周	6	1-14 周	15 周	16-20 周
7	6-16 周	17 周	1-5 周 18-20 周	8	1-16 毕业设计/实习 17 周答辩		

九、毕业生应具备的知识能力及实现矩阵

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
1.工程知识: 能够将数学、自然科学、工程基础和专业知识用于解决复杂测绘工程问题。	1.1 能将数学、自然科学、工程科学的语言工具用于测绘工程问题的表述	高等数学 A(1-2)、物理实验（1-2）、地球科学概论、CAD 基础与应用、数字地形测量学、地图学、遥感原理与应用、土木工程概论、计算机图形学等。
	1.2 能针对具体的测绘对象建立数学模型并求解	高等数学 A(1-2)、线性代数、误差理论与测量平差基础、大地测量学基础、摄影测量学等。
	1.3 能够将数学、自然科学、工程基础和专业知识以及数学模型方法用于推演、分析复杂测绘工程问题	计算思维导论、线性代数、地理信息系统原理（双语）、GNSS 原理及其应用、工程测量学、工程制图与识图、计算机图形学、遥感数字图像处理、城市规划概论等。
	1.4 能够将数学、自然科学、工程基础和专业知识以及数学模型方法用于复杂测绘工程问题解决方案的比较与综合	概率论与数理统计 B 、普通物理 B(1-2)、数据结构、控制测量实习、遥感原理与应用实习等。
2.问题分析: 能够应用数学、自然科学和工程科学的基本原理，识别、表达、并通过文献研究分析复杂测绘工程问题，以获得有效结论。	2.1 能运用数学、自然科学和工程科学原理，识别和判断复杂测绘工程问题的关键环节	计算思维导论、高等数学 A(1-2) 、概率论与数理统计 B 、普通物理 B(1-2)、地球科学概论、地图学、工程测量学、数据结构、C#程序设计、地图设计与编绘、遥感数字图像处理等。
	2.2 能基于数学、自然科学和工程科学原理和数学模型方法正确表达复杂测绘工程问题	线性代数、地理信息系统原理（双语）、误差理论与测量平差基础、GNSS 原理及其应用、激光雷达测量技术与应用、土木工程概论、测量程序设计与数据处理、工业测量与数据处理、工程测量综合实习、

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
		激光雷达测量技术实习、城市规划概论等。
	2.3 能认识到解决测绘问题有多种方案可选择，会通过文献研究寻求可替代的解决方案	遥感原理与应用、大地测量学基础、摄影测量学、变形监测与灾害预报、科技文献检索等。
	2.4 能运用数学、自然科学和工程科学的基本原理，借助文献研究，分析过程的影响因素，获得有效结论	概率论与数理统计 B、普通物理 B(1-2)、C 语言程序设计、高精度导航地图与位置服务、地理信息系统原理实习、遥感原理与应用实习、激光雷达测量技术实习、毕业设计等。
3.设计/开发解决方案：能够设计针对复杂测绘工程问题的解决方案，设计满足特定需求的测绘系统或测绘生产流程，并能够在设计环节中体现创新意识，考虑社会、健康、安全、法律、文化以及环境等因素。	3.1 掌握测绘工程设计、实施、管理等全流程相关技术，以及测绘地理信息产品的全周期生产方法，了解影响设计目标和技术方案的各种因素	C 语言程序设计、地图学、地理信息系统原理（双语）、误差理论与测量平差基础、不动产测量与管理、控制测量实习、空间信息综合实习、遥感数字图像处理、近景摄影测量、大数据与地理信息系统、遥感影像深度学习与智能解译等。
	3.2 能够针对特定需求，完成测绘系统、生产流程的设计	计算思维导论、CAD 基础与应用、GNSS 原理及其应用、摄影测量学、工程测量学、激光雷达测量技术与应用、数据结构、测量程序设计与数据处理、地图学实习、地理信息系统原理实习、控制测量实习、卫星导航定位实习、空间信息综合实习、地图设计与编绘等。
	3.3 能够进行测绘系统或测绘生产流程的设计，在设计中体现创新意识	变形监测与灾害预报、计算机图形学、工业测量与数据处理、毕业设计、测绘技能大赛实训、遥感应用前景等。
	3.4 在测绘系统或测绘生产流程的设计中能够考虑安全、健康、法律、文化及环境等制约因素	思想道德与法治、高精度导航地图与位置服务、毕业设计、自然资源调查监测等。
4.研究：能够基于科学原理并采用科学方法对复杂测绘工程问题进行研究，包括	4.1 能够基于科学原理，通过文献研究，采用科学方法，调研和分	误差理论与测量平差基础、大地测量学基础、智慧城市导论、不动产测量与管理实习、毕业设计、遥感应用前景、遥感数字

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
设计实验、分析与解释数据、并通过信息综合得到合理有效的结论。	析复杂测绘工程问题的解决方案	图形处理、大数据与地理信息系统、遥感影像深度学习与智能解译、科技论文写作（双语）等。
	4.2 能够根据测绘对象特征，选择研究路线，设计测绘技术方案	遥感原理与应用、工程制图与识图、地理信息系统原理实习、遥感原理与应用实习、工程测量综合实习、不动产测量与管理实习、测绘地理信息技术前沿等。
	4.3 能够根据测绘技术方案构建实验系统，安全地开展测绘实验，正确地采集测绘实验数据	数字地形测量学、激光雷达测量技术与应用、测量程序设计与数据处理、工业测量与数据处理、自然资源调查监测、数字地形测量实习、控制测量实习、摄影测量实习、卫星导航定位实习、C#程序设计、近景摄影测量、新型航空遥感数据处理技术等。
	4.4 能对实验结果进行分析和解释，并通过信息综合获得合理有效结论	线性代数、科技文献检索、地图学实习、空间信息综合实习、激光雷达测量技术实习、毕业设计、新型航空遥感数据处理技术等。
5.使用现代工具：能够针对复杂测绘工程问题，开发、选择与使用恰当的测绘技术、信息资源、现代测绘仪器和信息技术工具，包括对复杂测绘工程问题的预测与模拟，并能够理解其局限性。	5.1 了解测绘常用的现代测绘仪器、信息技术工具和测绘软件的使用原理和方法，并理解其局限性	计算思维导论、工程实践类、复合培养类、C 语言程序设计、地理信息系统原理（双语）、现代测绘技术应用、大地测量学基础、GNSS 原理及其应用、摄影测量学、工程测量学、数据结构、工程制图与识图、计算机图形学、智慧城市导论、地图学实习、GIS 基础应用技能、大数据与地理信息系统、新型航空遥感数据处理技术、遥感影像深度学习与智能解译、测绘地理信息技术前沿等。
	5.2 能够选择与使用恰当的现代测绘仪器、信息资源和测绘软件，对复杂测绘工程问题进行技术设计、数据处理与精度分析	高等数学 A(1-2)、概率论与数理统计 B、CAD 基础与应用、数字地形测量学、误差理论与测量平差基础、不动产测量与管理、城市遥感（双语）、数字地形测量实习、地理信息系统原理实习、遥感原理与应用实习、工程测量综合实习、不动产测量与管理实习、激光雷达测量技术实习、测绘技能大赛实训、C#程序设计、地图设计与

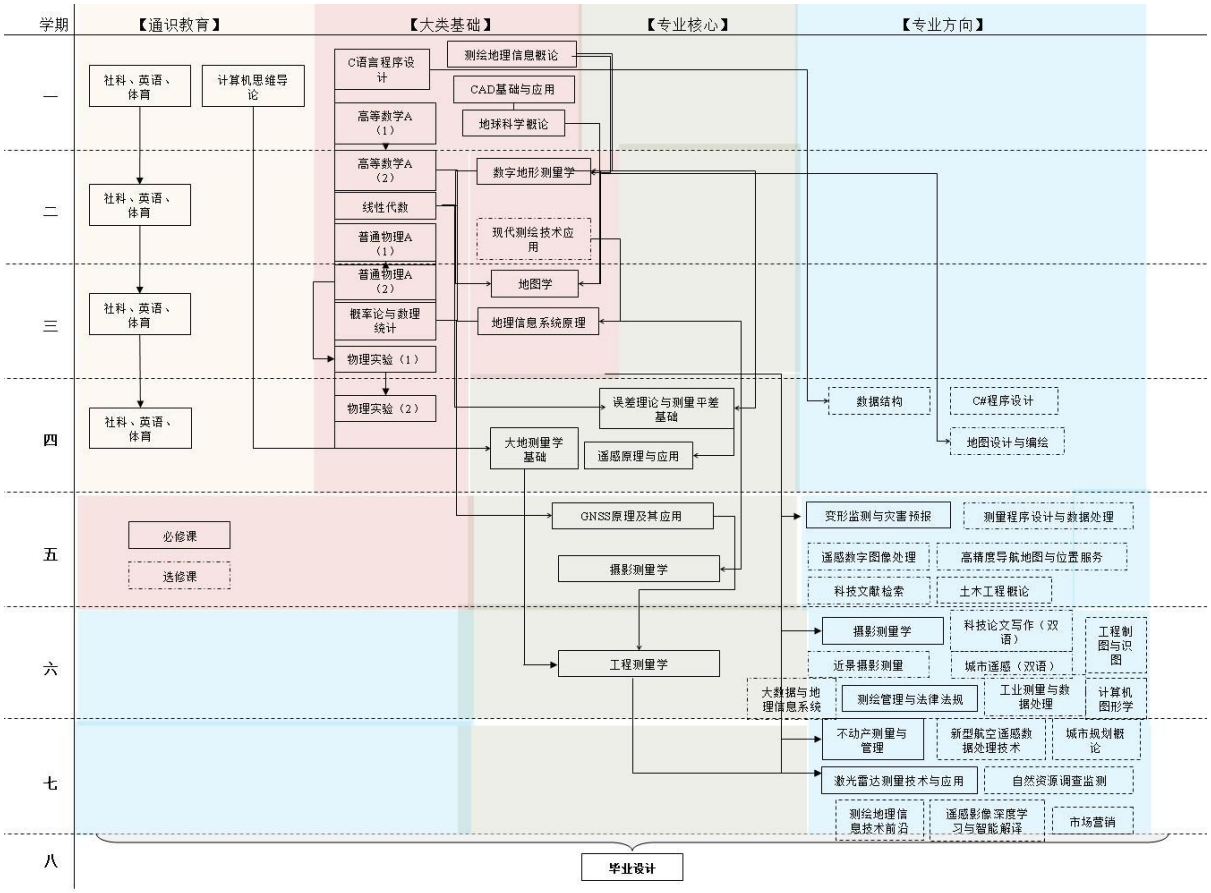
毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
		编绘、近景摄影测量等。
	5.3 能够针对具体的测绘对象，开发或选用满足特定需求的现代测绘仪器、信息技术工具，对复杂测绘工程问题进行预测与模拟，并能够分析其局限性	普通物理 B（1-2）、变形监测与灾害预报、激光雷达测量技术与应用、科技文献检索、高精度导航地图与位置服务、测量程序设计与数据处理、工业测量与数据处理、遥感原理与应用实习、摄影测量实习、新型航空遥感数据处理技术等。
6.工程与社会：能够基于工程相关背景知识进行合理分析，评价测绘工程实践和复杂测绘工程问题解决方案对社会、健康、安全、法律以及文化的影响，并理解应承担的责任。	6.1 了解测绘领域的技术标准体系、知识产权、测绘管理政策和法律法规，理解不同社会文化对工程活动的影响	形势与政策、数字地形测量学、遥感原理与应用、大地测量学基础、测绘管理与法律法规、数字地形测量实习、地理信息系统原理实习、卫星导航定位实习、工程测量综合实习、测绘技能大赛实训、城市规划概论等。
	6.2 能分析和评价测绘工程实践对社会、健康、安全、法律、文化的影响，以及这些制约因素对工程项目实施的影响，并理解应承担的责任	思想道德与法治、中国近现代史纲要、马克思主义基本原理、毛泽东思想和中国特色社会主义理论体系概论、工程实践类、复合培养类、现代测绘技术应用、变形监测与灾害预报、不动产管理与测量、高精度导航地图与位置服务、土木工程概论、空间信息综合实习、毕业设计、GIS 基础与应用技能等。
7.环境和可持续发展：能够理解和评价针对复杂测绘工程问题的测绘工程实践对环境、社会可持续发展的影响。	7.1 知晓和理解环境保护和可持续发展的理念和内涵	习近平新时代中国特色社会主义思想概论、工程实践类、复合培养类、地球科学概论、测绘地理信息概论、城市遥感（双语）、自然资源调查监测、GIS 基础应用技能、城市规划概论等。
	7.2 能够从环境保护和可持续发展的角度思考测绘工程实践的可持续性，评价测绘工程实践中可能对人类和环境造成的损害和隐患	毛泽东思想和中国特色社会主义理论体系概论、形势与政策、智慧城市导论、自然地理地貌及遥感图像解译实习、毕业设计、大数据与地理信息系统等。
8.职业规范：具有人文社会科学素养、社会责任感，能	8.1 具有正确价值观，理解个人与社会的关	中国近现代史纲要、马克思主义基本原理、习近平新时代中国特色社会主义思想概

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
够在测绘工程实践中理解并遵守测绘行业职业道德和规范，履行责任。	系，了解中国国情	论、毛泽东思想和中国特色社会主义理论体系概论、形势与政策、体育（1-4）、“四史”（党史、新中国史、改革开放史、社会主义发展史）、自然资源调查监测、军事理论、军训、遥感影像深度学习与智能解译等。
	8.2 理解诚实公正、诚信守则的测绘行业职业道德和规范，并能在测绘工程实践中自觉遵守	思想道德与法治、大学生职业生涯与发展规划、测绘地理信息概论、测绘管理与法律法规、数字地形测量实习、工程测量综合实习、不动产测量与管理实习、测绘技能大赛实训等。
	8.3 理解测绘工作人员对公众的安全、健康、福祉、环境保护的社会责任，能够在测绘工程实践中自觉履行责任	马克思主义基本原理、习近平新时代中国特色社会主义思想概论、大学生心理健康、地球科学概论、变形监测与灾害预报、城市遥感（双语）、自然地理地貌及遥感图像解译实习、毕业设计等。
9.个人和团队：能够在建筑、土木等多学科背景下的团队中承担个体、团队成员以及负责人的角色。	9.1 能与建筑、土木等多学科的成员有效沟通，合作共事	大学生职业生涯与发展规划、体育（1-4）、土木工程概论、工程制图与识图、自然地理地貌及遥感图像解译实习、工程测量综合实习、不动产测量与管理实习、毕业设计等。
	9.2 能够在团队中独立或合作开展工作	大学生心理健康、军事理论、数字地形测量实习、地图学实习、卫星导航定位实习、激光雷达测量技术实习等。
	9.3 能够组织、协调和指挥团队开展工作	控制测量实习、空间信息综合实习、测绘技能大赛实训等。
10.沟通：能够就复杂测绘工程问题与测绘同行及社会公众进行有效沟通和交流，包括撰写测绘技术设计书和测绘技术总结等、陈述发言、清晰表达或回应指令，并具备一定的国际视野，能够在跨文化背景下进行沟通和交流。	10.1 能就测绘专业问题，在测绘技术设计书、测绘技术总结等书面表述以及陈述发言中，准确表达观点，回应质疑，理解与测绘同行及社会公众交流的差异性	测绘管理与法律法规、工程测量综合实习、空间信息综合实习、激光雷达测量技术实习、毕业设计、科技论文写作（双语）、市场营销等。
	10.2 了解测绘专业领域的国际发展趋势、研究热点，理解和尊重不	大学英语拓展系列课程、测绘地理信息概论、地理信息系统原理（双语）、现代测绘技术应用、遥感应用前景、科技论文写

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
	同文化的差异性和多样性	作（双语）等。
	10.3 具备跨文化交流的语言和书面表达能力，能就测绘专业问题，在跨文化背景下进行基本沟通和交流	大学英语（1-2）、大学英语拓展系列课程、城市遥感（双语）、科技论文写作（双语）等。
11.项目管理：理解并掌握工程管理原理与经济决策方法，并能在测绘、建筑、土木、环境等多学科环境中应用。	11.1 了解测绘工程及测绘产品生产的全流程成本构成，能够理解其中涉及的工程管理与经济决策问题，并能掌握工程项目中涉及的管理与经济决策方法	不动产测量与管理、测绘管理与法律法规、空间信息综合实习、毕业设计、市场营销等。
	11.2 能在土木、建筑等多学科环境下，在设计开发测绘方案的过程中，运用工程管理与经济决策方法	土木工程概论、工程测量综合实习、毕业设计等。
12.终身学习：具有自主学习和终身学习的意识，有不断学习和适应发展的能力。	12.1 能在社会发展的大背景下，认识到自主学习和终身学习的必要性	大学生职业生涯与发展规划、数字地形测量学、测绘技能大赛实训、测绘地理信息技术前沿等。
	12.2 具有自主学习和适应发展的能力，包括对测绘技术问题的理解能力，归纳总结的能力和提出问题的能力等。	马克思主义基本原理、大学英语（1-2）、体育（1-4）、C 语言程序设计、现代测绘技术应用、工程测量学、摄影测量实习、毕业设计、遥感应用前景等。

十、指导性教学计划（见附表）

十一、主要课程逻辑关系结构图



2022 Undergraduate Program for Specialty in Surveying and Mapping Engineering

I Specialty Name and Code

English Name	**Surveying and Mapping Engineering**		
Code	081201	Disciplines	Engineering
Length of Schooling	Four years	Degree	Bachelor of Engineering

II Educational Objectives and Features

1.Objectives

This program is to cultivate all-round development of morality, intelligence, physique, beauty and labor, master the basic theory, basic knowledge and basic skills of Surveying and mapping engineering, accept the training of scientific thinking and engineering practice, have humanistic quality, professional ethics and social responsibility, and be competent for the design, production and research of Surveying and mapping projects in national basic surveying and mapping, urban and rural construction, natural resource monitoring, geographic information service and emergency management Development and management, with strong organization and management ability, innovation consciousness, continuous learning ability, international vision and urban surveying and mapping characteristics of Applied Engineering and technical personnel. After five years of work and study after graduation, students can achieve the following goals:

(1) Capable of Surveying and mapping technology in national basic surveying and mapping, urban and rural construction, geographic information service and emergency management, etc;

(2) With good professional quality, rich engineering management experience and strong sense of responsibility, he has become the technical director or technical backbone of Surveying and mapping geographic information enterprises and institutions;

(3) Have the ability to continue learning to adapt to the development, and be able to independently or cooperatively undertake the scientific research of Surveying and mapping geographic information;

(4) Have good team consciousness, international vision and communication ability, be able to play the role of organizational management backbone or technical director in design, production, R & D and multidisciplinary teams, with team spirit and leadership;

(5) With good ideological and moral cultivation and scientific and cultural literacy, with a sense of social responsibility, dedication and good professional ethics, can undertake and perform social responsibility, serve the country and society.

2. Features

Relying on the advantages of capital construction and civil architecture discipline, this major cultivates professional surveying and mapping talents serving the capital, facing the whole country, relying on the construction industry and serving urban and rural construction. Personnel training adapts to the

development of high-tech surveying and mapping, integrates teaching, scientific research and production, emphasizes the close combination of theory and practice, cultivates the application ability of new technology, new method and new process of Surveying and mapping, highlights the characteristics of Urban Surveying and mapping, and meets the needs of Surveying and mapping talents such as urban and rural construction, protection of ancient buildings and precise measurement of complex structures.

III Major Disciplines

Science and Technology of Surveying and Mapping

IV Major Courses

1. Basic Courses

Introduction to Geomatics, Engineering Drawing and Read Drawing, C Language Programming Design, Data Structure, Introduction to Earth Science, Digital Topographic Surveying, Cartography, CAD Basic and Application, Fundamentals of Error Theory and Surveying Adjustment, Foundation of Geodesy, The Principle of Geographic Information System (Bilingual), Application and Principles of Remote Sensing, Photogrammetry.

2. Specialty Courses

Application and Principles of GNSS, Engineering Surveying, Deformation Monitoring and Disasters Predicting, Real Estate Surveying and Management, Application and Technology of Laser Radar Surveying.

V Major Practical Training

1. Major experiment

Experiment of Digital Topographic Surveying, Experiment of Satellite Navigation and Positioning Technology, Experiment of Photogrammetry, Experiment of GIS Principles, Experiment of Geodesy, Experiment of Engineering Surveying, Experiment of Deformation Monitoring, Experiment of Real Estate Surveying and Management, Experiment of Application and Technology of Laser Radar Surveying.

2. Major Practical Training

Digital Topographic Surveying Practice, Satellite Navigation and Positioning Practice, Principles of Remote Sensing Practice, Photogrammetry Practice, GIS Practice, Cartography Practice, Control Surveying Practice, Interpretation of Physical Geography,Geomorphology and Remote Sensing Image Practice, Comprehensive Training for Engineering Surveying, Comprehensive Training for Spatial Information, Real Estate Surveying and Management Practice, Laser Radar Surveying Practice.

VI Graduation Requirements

In accordance with "Management Regulations for the Undergraduate Students of Beijing University of Civil Engineering and Architecture" and "Bachelor's Degree Awarding Regulations", the minimum

credits required by specialty for graduate is 173, including 133 credits of theoretical courses and 40 credits of practice teaching (2 credits of compulsory innovation practice and scientific research training included).

VII Proportion of Course

Course Category	Course Type	Credits	Class Hour	Proportion
General Education	Compulsory	43.5	736	25.14%
	Optional	2	32	1.16%
Big Academic Subjects	Compulsory	43	756	24.86%
	Optional	1	16	0.58%
Professional Core	Compulsory	16	256	9.25%
Professional Direction	Compulsory	7	112	4.05%
	Optional	20.5	328	11.85%
Practice	Compulsory	38	872	21.97%
	Optional	2	40	1.16%
Total		173	3148	100%

VIII Table of Teaching Program

Semester	Teaching	Exam	Practice	Semester	Teaching	Exam	Practice
1	4-19	20	1-3	2	1-16	17	18-20
3	1-15	16	17-20	4	1-16	17	18-20
5	1-16	17-18	19-20	6	1-14	15	16-20
7	6-16	17	1-5 18-20	8	1-16 graduation project 17 defense		

IX Graduate Abilities and Matrices

Graduate Abilities	Related Knowledge	Course Supports
1. Engineering knowledge: Be able to use mathematics, natural science, engineering foundation and professional knowledge to solve complex surveying and mapping engineering problems.	1.1 Be able to use the language tools of mathematics, natural science and engineering science to express surveying and mapping engineering problems	Advanced mathematics a (1-2) , physical experiments (1-2) , introduction to Earth Science, fundamentals and applications of CAD, digital topographic surveying, cartography, principles and applications of remote sensing, introduction to civil engineering, computer graphics, etc. .
	1.2 Be able to establish mathematical model and solve for specific surveying and mapping	Advanced mathematics a (1-2) , LINEAR Algebra, error theory and adjustment basis, geodesy basis, photogrammetry, etc. .

Graduate Abilities	Related Knowledge	Course Supports
	objects	
	1.3 Be able to use mathematics, natural science, engineering foundation and professional knowledge as well as mathematical model method to deduce and analyze complex surveying and mapping engineering problems	Introduction to computational thinking, Linear Algebra, Gis (bilingual) , GNSS and its applications, engineering surveying, engineering cartography and cartography, computer graphics, Remote Sensing Digital Image Processing, introduction to urban planning, etc.
	1.4 Can use mathematics, natural science, engineering foundation and professional knowledge as well as mathematical model method to compare and synthesize the solutions of complex surveying and mapping engineering problems	Probability and Mathematical Statistics B, General Physics B (1-2) , data structure, control measurement practice, remote sensing principle and application practice, etc. .
2. Problem analysis: Be able to apply the basic principles of mathematics, natural science and engineering science to identify, express and analyze complex surveying and mapping engineering problems through literature research, so as to obtain effective conclusions.	2.1 Be able to identify and judge the key links of complex surveying and mapping engineering problems by using the principles of mathematics, natural science and engineering science	Introduction to computational thinking, advanced mathematics a (1-2) , probability and Mathematical Statistics B, General Physics B (1-2) , introduction to Earth Science, cartography, engineering surveying, data structure, c # program design, map design and compilation, remote sensing digital image processing, etc. .
	2.2 Be able to correctly express complex surveying and mapping engineering problems based on the principles of	Linear Algebra, geographic information system (bilingual) , error theory and surveying adjustment basis, GNSS principle and its application, laser radar surveying technology and application, introduction to civil

Graduate Abilities	Related Knowledge	Course Supports
	mathematics, natural science and Engineering Science and mathematical model	engineering, surveying program design and data processing, industrial surveying and data processing, engineering surveying comprehensive practice, laser radar surveying technology practice, introduction to urban planning, etc. .
	2.3 Can realize that there are many solutions to solve the problem of Surveying and mapping, and will seek alternative solutions through literature research	Principles and applications of remote sensing, geodesy, photogrammetry, deformation monitoring and disaster prediction, scientific and technical literature retrieval, etc. .
	2.4 Can use the basic principles of mathematics, natural science and Engineering Science, with the aid of literature research, analyze the influencing factors of the process, and obtain effective conclusions	Probability theory and Mathematical Statistics B, General Physics B (1-2) , C language program design, high-precision Navigation Map and position service, geographic information system principle practice, remote sensing principle and application practice, laser radar measurement technology practice, graduation project, etc. .
3. Design/Develop solutions: Be able to design solutions for complex surveying and mapping engineering problems, design surveying and mapping system or surveying and mapping production process to meet specific needs, reflect innovation consciousness in the	3.1 Master the technology related to the whole process of Surveying and mapping engineering design, implementation and management, as well as the full cycle production method of Surveying and mapping geographic information products, and understand various factors affecting the design objectives and	C language programming, cartography, Gis (bilingual) , error theory and surveying adjustment basis, real estate surveying and management, control surveying practice, spatial information synthesis practice, remote sensing digital image processing, Chikakage photogrammetry, big data and gis, remote sensing image depth learning and intelligent interpretation, etc. .

Graduate Abilities	Related Knowledge	Course Supports
design process, and consider factors such as society, health, safety, law, culture and environment.	technical solutions	
	3.2 Be able to complete the design of Surveying and mapping system and production process according to specific requirements	Introduction to computational thinking, Cad Foundation and application, GNSS principle and its application, photogrammetry, engineering surveying, laser radar measurement technology and application, data structure, measurement program design and data processing, cartography practice, geographic information system principle practice, control and measurement practice, satellite navigation and positioning practice, space information synthesis practice, map design and compilation, etc..
	3.3 Be able to design the surveying and mapping system or production process, and embody the innovation consciousness in the design	Deformation monitoring and disaster prediction, computer graphics, industrial surveying and data processing, graduation design, surveying and mapping skills contest training, remote sensing application prospects, etc. .
	3.4 In the design of Surveying and mapping system or mapping production process, the constraints of safety, health, law, culture and environment can be considered	Ideological and moral and rule of law, High-precision navigation map and location services, graduation design, natural resources survey and monitoring.
4. Research: Based on scientific principles and scientific methods, it can study complex surveying and mapping engineering problems, including designing experiments, analyzing and interpreting data,	4.1 Based on scientific principles, through literature research, using scientific methods, research and analyze the solutions of complex surveying and mapping engineering problems	Error Theory and surveying adjustment basis, geodesy basis, intelligent city introduction, real estate surveying and management practice, graduation design, remote sensing application prospects, remote sensing digital graphics processing, Big Data and geographic information system, remote sensing image depth learning and intelligent interpretation, scientific and technical paper writing (bilingual) .

Graduate Abilities	Related Knowledge	Course Supports
and obtaining reasonable and effective conclusions through information synthesis.	4.2 According to the characteristics of Surveying and mapping objects, the research route can be selected and the technical scheme of Surveying and mapping can be designed	Remote sensing principle and application, engineering cartography and map recognition, gis principle practice, remote sensing principle and application practice, engineering survey comprehensive practice, real estate survey and management practice, and so on.
	4.3 It can construct the experimental system according to the technical scheme of Surveying and mapping, carry out the surveying and mapping experiment safely, and collect the surveying and mapping experimental data correctly	Digital topographic survey, laser radar survey technology and application, survey program design and data processing, industrial survey and data processing, Natural Resources Survey and Monitoring, digital topographic survey practice, control survey practice, photogrammetry practice, satellite navigation and positioning practice, c # program design, close-range photogrammetry, new aerial remote sensing data processing technology, etc. .
	4.4 The experimental results can be analyzed and explained, and reasonable and effective conclusions can be obtained through information synthesis	Linear Algebra, science and Technology Literature Retrieval, cartography practice, spatial information comprehensive practice, laser radar measurement technology practice, graduation design, new aviation remote sensing data processing technology.
5. Using modern tools: Be able to develop, select and use appropriate surveying and mapping technology, information resources, modern surveying and mapping instruments and information technology tools, including	5.1 Understand the principles and methods of modern surveying and mapping instruments, information technology tools and mapping software commonly used in surveying and mapping, and understand their limitations	Introduction to computational thinking, engineering practice, composite training, C language programming, principles of geographic information system (bilingual) , application of modern surveying and mapping technology, geodesy, Gnss principles and applications, photogrammetry, engineering surveying, data structure, engineering mapping and cartography, computer graphics, introduction to Smart Cities, cartographic practice, Gis basic application skills, big data

Graduate Abilities	Related Knowledge	Course Supports
prediction and Simulation of complex surveying and mapping engineering problems, and understand their limitations.		and Gis, new aerial remote sensing data processing technology, deep learning and intelligent interpretation of remote sensing images, frontier of Surveying and Mapping Geographic Information Technology, etc. .
	5.2 Be able to select and use appropriate modern surveying and mapping instruments, information resources and surveying and mapping software to carry out technical design, data processing and accuracy analysis for complex surveying and mapping engineering problems	Advanced mathematics a (1-2) , probability theory and mathematical statistics B, CAD basis and application, digital topographic surveying, error theory and surveying adjustment basis, real estate surveying and management, Urban Remote Sensing (bilingual) , digital topographic surveying practice, geographic information system principle practice, remote sensing principle and application practice, engineering surveying comprehensive practice, real estate surveying and management practice, laser radar surveying technology practice, mapping skills competition training, c # programming, map design and compilation, Chikakage photogrammetry, etc. .
	5.3 It can develop or select modern surveying and mapping instruments and information technology tools to meet specific needs for specific surveying and mapping objects, predict and simulate complex surveying and mapping engineering problems, and analyze their limitations	General Physics B (1-2) , deformation monitoring and disaster prediction, laser radar survey technology and application, scientific and technical literature retrieval, high precision navigation map and position service, survey program design and data processing, industrial survey and data processing, remote sensing principle and application practice, photogrammetry practice, new aviation remote sensing data processing technology, etc. .
6. Engineering and Society: Be able to make reasonable	6.1 Understand the technical standard system, intellectual property	Situation and policy, digital topographic surveying, principles and applications of remote sensing, fundamentals of Geodesy, management

Graduate Abilities	Related Knowledge	Course Supports
analysis based on engineering related background knowledge, evaluate the impact of Surveying and mapping engineering practice and complex surveying and mapping engineering problem solutions on society, health, safety, law and culture, and understand the responsibilities that should be undertaken.	rights, surveying and mapping management policies, laws and regulations in the field of Surveying and mapping, and understand the influence of different social cultures on engineering activities	and laws and regulations of surveying and Mapping, practice of digital topographic surveying, practice of geographic information system principles, practice of satellite navigation and positioning, comprehensive practice of engineering surveying, practice of surveying and Mapping Skills Contest, introduction to urban planning, etc. .
	6.2 Be able to analyze and evaluate the impact of Surveying and mapping engineering practice on society, health, safety, law and culture, as well as the impact of these constraints on the implementation of engineering projects, and understand the responsibilities that should be borne	Ideological Morality and rule of law, outline of history of China, basic principles of Marxism, introduction to the theoretical system of Maoism and socialism with Chinese characteristics, engineering practice, compound cultivation, application of modern surveying and mapping technology, deformation monitoring and disaster prediction, real estate management and surveying, high precision navigation map and location service, introduction to civil engineering, comprehensive practice of spatial information, graduation design, Gis Foundation and application skills, etc. .
7.Environment and sustainable development : Be able to understand and evaluate the impact of complex surveying and mapping engineering practice on the environment and social sustainable development.	7.1 Know and understand the concept and connotation of environmental protection and sustainable development	An introduction to Xi Jinping thought on Socialism with Chinese characteristics for a new era, an introduction to engineering practice, composite training, an introduction to Earth Science, an introduction to surveying, mapping and geographic information, urban remote sensing (bilingual) , natural resources investigation and monitoring, basic application skills of Gis, an introduction to urban planning, etc. .
	7.2 From the perspective of environmental protection and sustainable	An introduction to the theoretical system of Maoism and socialism with Chinese characteristics, situation and policies,

Graduate Abilities	Related Knowledge	Course Supports
	development, we can think about the sustainability of Surveying and mapping engineering practice, and evaluate the damage and hidden danger that may be caused to human and environment in the practice of Surveying and mapping engineering	introduction to smart cities, physical geography and remote sensing image interpretation practice, graduation project, big data and GIS, etc. .
8. Occupational norms: With humanities and social science literacy, social responsibility, can understand and abide by the professional ethics and norms of Surveying and mapping industry in the practice of Surveying and mapping, and fulfill the responsibility.	8.1 Have correct values, understand the relationship between individuals and society, and understand China's national conditions	An outline of the history of China, an introduction to the basic principles of Marxism, an introduction to Xi Jinping's thought on Socialism with Chinese characteristics for a new era, an introduction to Maoism and the theoretical system of socialism with Chinese characteristics, the situation and policies, sports (1-4) , the "Four Histories" (the history of the party, the history of the New China, the history of reform and opening-up, and the history of Socialist Development) , natural resources investigation and monitoring, military theory, military training, deep learning of remote sensing images and intelligent interpretation, etc. .
	8.2 Understand the professional ethics and norms of the surveying and mapping industry of honesty, justice and integrity, and consciously abide by them in the practice of Surveying and mapping projects	Ideological Morality and rule of law, college students'career and Development Planning, survey and Mapping Geographic Information, survey and Mapping Management and laws and regulations, digital topographic survey practice, engineering survey comprehensive practice, real estate survey and management practice, survey and mapping skills contest training, etc. .
	8.3 Understand the social	An introduction to the basic principles of

Graduate Abilities	Related Knowledge	Course Supports
	responsibility of Surveying and mapping workers for public safety, health, well-being and environmental protection, and be able to consciously perform their responsibilities in surveying and mapping engineering practice	Marxism, an introduction to Xi Jinping's thought on Socialism with Chinese characteristics for a new era, an introduction to college students'mental health, an introduction to Earth Science, deformation monitoring and disaster prediction, urban remote sensing (bilingual) , physical geography and remote sensing image interpretation practice, graduation project, etc. .
9. Individuals and teams: Be able to play the role of individual, team member and leader in the team under the background of architecture, civil engineering and other disciplines.	9.1 Be able to communicate effectively with members of architecture, civil engineering and other disciplines	College Students'career and development planning, physical education (1-4) , introduction to civil engineering, engineering drawing and mapping, physical geography and remote sensing image interpretation practice, engineering survey comprehensive practice, real estate survey and management practice, graduation design, etc. .
	9.2 Ability to work independently or cooperatively in a team	College Students Mental Health, military theory, digital terrain survey practice, mapping practice, satellite navigation positioning practice, laser radar measurement technology practice.
	9.3 Ability to organize, coordinate and direct the work of the team	Control survey practice, spatial information comprehensive practice, mapping skills contest training, and so on.
10. Communication: Be able to effectively communicate and communicate with surveying and mapping peers and the public on complex surveying and mapping engineering problems, including writing surveying and	10.1 Be able to accurately express opinions, respond to queries, and understand the differences of communication with surveying and mapping peers and the public in written statements and statements on surveying and mapping technology	Surveying and Mapping Management and laws and regulations, engineering survey comprehensive practice, spatial information comprehensive practice, laser radar survey technical practice, graduation design, scientific paper writing (bilingual) , marketing and so on

Graduate Abilities	Related Knowledge	Course Supports
mapping technology design book and surveying and mapping technology summary, making statements, clearly expressing or responding to instructions, and having a certain international vision, and being able to communicate and exchange in cross-cultural background.	design book and survey technology summary	
	10.2 Understand the international development trends and research hotspots in the field of Surveying and mapping, and understand and respect the differences and diversity of different cultures	College English extension courses, introduction to mapping and geographic information, principles of geographic information system (bilingual) , application of modern surveying and Mapping Technology, prospects of remote sensing applications, scientific paper writing (bilingual) and so on.
	10.3 Have the ability of cross-cultural communication language and written expression, and be able to carry out basic communication and exchange on surveying and mapping professional issues under the cross-cultural background	College English (1-2) , College English Extension Courses, urban remote sensing (bilingual) , scientific paper writing (bilingual) and so on.
11. Project management: Understand and master the principles of engineering management and economic decision-making methods, and can be applied in surveying and mapping, architecture, civil engineering, environment and other disciplines.	11.1 understand the cost structure of the whole process of surveying and mapping engineering and surveying products production, understand the engineering management and economic decision-making issues involved, and grasp the management and economic decision-making methods involved in engineering	Real Estate Survey and management, surveying and Mapping Management and laws and regulations, spatial information comprehensive practice, graduation design, marketing and so on.

Graduate Abilities	Related Knowledge	Course Supports
	projects	
	11.2 application of engineering management and economic decision-making in the design and development of surveying and mapping schemes in multidisciplinary environments such as civil engineering and architecture	Civil Engineering Conspectus, engineering survey comprehensive practice, graduation project and so on.
12. Lifelong learning: Have the consciousness of self-learning and lifelong learning, and have the ability of continuous learning and adapting to development.	12.1 Under the background of social development, we can realize the necessity of self-learning and lifelong learning	College Students Career and Development Planning, digital terrain surveying, mapping skills contest training, mapping and geographic information technology frontier.
	12.2 Have the ability of self-learning and adapting to development, including the ability to understand the surveying and mapping technical problems, the ability to summarize and the ability to ask questions.	Basic Principles of Marxism, college English (1-2) , sports (1-4) , C language programming, application of modern surveying and Mapping Technology, engineering surveying, photogrammetry practice, graduation design, remote sensing application prospects, etc. .

X Table of Teaching Arrangement (appendix table)

表 1　测绘工程专业指导性教学计划

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续学时	开课学期	教学单位
通识教育课	必修	思想道德与法治 Ideological Morality and Rule of Law	3	48	48					1	马克思主义学院
		中国近现代史纲要 The Outline of the Modern Chinese History	3	48	32			16		2	马克思主义学院
		习近平新时代中国特色社会主义思想概论 Introduction to Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era	3	48	48					2	马克思主义学院
		习近平新时代中国特色社会主义思想在京华大地的生动实践 The Vivid Practice of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era in Beijing	0.5	8	8					2	马克思主义学院
		马克思主义基本原理★ Basic Principle of Marxism	3	48	48					3	马克思主义学院
		毛泽东思想和中国特色社会主义理论体系概论★ Introduction to Mao Zedong Thoughts and Theoretical System of Socialism with Chinese Characteristics	3	48	48					4	马克思主义学院
		形势与政策（1-4） Situation and Policy(1-4)	2	32	32					1-4	马克思主义学院
		大学生职业生涯与发展规划 College Student Occupation Career and Development Planning	1	16	16					1	学工部
		大学生心理健康 The Mental Health of College Students	1	16	16					2	学工部
		大学英语(1-2) ★ College English(1-2)	6	128	96				32	1-2	人文学院
		大学英语拓展系列课程（1-4） College English Training（1-4）	2	32	32					3	人文学院
		大学英语拓展系列课程（5-8） College English Training（5-8）	2	32	32					4	人文学院
		体育(1-4) Physical Education(1-4)	4	120	120					1-4	体育部
		计算思维导论 Introduction to Computational Thinking	1.5	56	24			32		1	电信学院
		“四史”（党史、新中国史、改革开放史、社会主义发展史） History of the Communist Party of China, History of New China, History of Reform and Opening up and History of Socialist Development	0.5	8	8					1-7	马克思主义学院
		小 计	35.5	688	608			48	32		
	核心	特色课程与人文素养	2	32						1-8	各院部
		经典研读与文化传承	2	32						1-8	各院部
		科技文明与城市发展	2	32						1-8	各院部
		建筑艺术与审美教育	2	32						1-8	各院部
		修读 4 类合计 8 学分，每类至少修读 2 学分									
	任选	工程实践类	1-8 学期任选								各院部
		复合培养类	1-8 学期任选								各院部
		任选至少修读 2 学分									
	通识教育课合计至少修读 45.5 学分。其中通识教育必修 35.5 学分（含“四史”（党史、新中国史、改革开放史、社会主义发展史），四选一，1-7 学期内任意学期完成，0.5 学分），通识教育核心 8 学分，通识教育任选 2 学分（含体育类课程 1 学分）。										

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
大类基础课	必修	高等数学 A（1）★ Advanced Mathematics A(1)	5	92	80				12	1	理学院
		高等数学 A（2）★ Advanced Mathematics A(2)	5	84	80				4	2	理学院
		线性代数 Linear Algebra	2	40	32				8	2	理学院
		概率论与数理统计 B Theory of Probability and Statistics (B)	3	48	44				4	3	理学院
		普通物理 A（1）★ College physics A(1)	3	56	52			4		2	理学院
		普通物理 A（2）★ College physics A(2)	3	56	52			4		3	理学院
		物理实验（1-2） Physics Experiment(1-2)	2	60		60				3-4	理学院
		C 语言程序设计 ★ C Programming Language	2	32	24	8				1	地理信息科学系
		地球科学概论 Introduction to Earth Science	2	32	32					1	地理信息科学系
		测绘地理信息概论 Introduction to Geomatics	1	16	16					1	测绘学院
		CAD 基础与应用 CAD Basic and Application	2	32	16	16				1	测绘工程系
		数字地形测量学★ Digital Topographic Surveying	4	64	52	12				2	测绘工程系
		地图学 Cartography	3	48	40	8				3	地理信息科学系
		地理信息系统原理(双语)★ The Principle of Geographic Information System	3	48	40	8				3	地理信息科学系
		遥感原理与应用★ Principles of Remote Sensing and Application	3	48	48					3	遥感工程系
		小 计	43	756	608	112		8	28		
	选修	现代测绘技术应用 Application of Modern Surveying and Mapping Technology	1	16	16					2	测绘工程系
		GIS 基础应用技能 GIS base Application Skill	1	16	8	8				2	地理信息科学系
		遥感应用前景 Remote Sensing Applicantion Prospect	1	16	16					3	遥感工程系
		小 计	3	48	40	8					
	大类学科基础课合计 44 学分，必修 43 学分，任选 1 学分										
专业核心课	必修	误差理论与测量平差基础 ★ Fundamentals of Error Theory and Surveying Adjustment	3	48	48					4	测绘工程系
		大地测量学基础★ Foundation of Geodesy	3	48	40	8				4	测绘工程系
		GNSS 原理及其应用★ The Application and Principles of GNSS	3	48	44	4				5	测绘工程系
		摄影测量学★ Photogrammetry	3	48	40	8				5	遥感工程系
		工程测量学★ Engineering Surveying	4	64	56	8				6	测绘工程系
		小计	16	256	228	28					
	专业核心课合计必修 16 学分										

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
专业方向课	必修	变形监测与灾害预报 Deformation Monitoring and Disasters Predicting	2	32	24	8				5	测绘工程系
		测绘管理与法律法规 Surveying Management and Laws	1	16	16					6	测绘工程系
		不动产测量与管理 Real Estate Surveying and Management	2	32	28	4				7	测绘工程系
		激光雷达测量技术与应用 The Application and Technology of Laser Radar Surveying	2	32	24	8				7	测绘工程系
		小 计	7	112	92	20					
	选修	C#程序设计 C# Programming	2	32	16	16				4	地理信息科学系
		地图设计与编绘 Map Design and Compilation	2	32	16	16				4	地理信息科学系
		数据结构（限选） Data structure	2	32	24	8				4	地理信息科学系
		遥感数字图像处理 Remote Sensing Digital Image Processing	2	32	24	8				5	遥感工程系
		科技文献检索 Document Retrieval of Science and Technology	1	16	16			8		5	图书馆
		高精度导航地图与位置服务（限选） High-Precision Navigation Map and Location Service	2	32	32					5	测绘工程系
		土木工程概论（限选） Introduction to Civil Engineering	3	48	48					5	土木学院
		测量程序设计与数据处理(限选）Surveying Data Processing and Programming	2	32	20		12			5	测绘工程系
		工程制图与识图 （限选） Engineering Drawing and Interpreting	3	48	48					6	理学院
		计算机图形学（限选） Computer Graphics	2	32	24	8				6	地理信息科学系
		工业测量与数据处理（限选） Industry Surveying and Data Processing	1.5	24	24					6	测绘工程系
		城市遥感（双语）（限选） Urban Remote Sensing	1.5	24	16	8				6	遥感工程系
		近景摄影测量 Close-range Photogrammetry	2	32	26	6				6	遥感工程系
		大数据与地理信息系统 Big Data and GIS	1.5	24	16	8				6	地理信息科学系
		智慧城市导论 （限选） Introduction to Smart City	1	16	16					6	地理信息科学系
		科技论文写作（双语） Scientific Paper writing	1	16	16					6	测绘工程系
		自然资源调查监测（限选） Natural resources survey and monitoring	1.5	24	16	8				7	地理信息科学系
		新型航空遥感数据处理技术 Modern aerial remote sensing data processing technology	2	32	32					7	遥感工程系
		遥感影像深度学习与智能解译 Deep learning and intelligent interpretation of remote sensing image	2	32	32					7	遥感工程系

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
		测绘地理信息技术前沿 Advanced Technology of Surveying, Mapping and GIS	1	16	16					7	测绘学院
		城市规划概论 Conspectus of Urban Planning	1.5	24	20	4				7	建筑学院
		市场营销 Marketing Management	1.5	24	24					7	经管学院
		小 计	39	624	522	90	12	8			
	专业方向课合计 27.5 学分，必修 7 学分，任选至少修读 20.5 学分										

表 2　测绘工程专业指导性教学计划（实践环节）

课程属性	课程名称		学分	折合学时	实验实践	上机	开课学期	开设周次	教学单位
课内	军事理论 Military Theory		2	36			1	1-3	武装部
	军训 Military Training		2	112					
	劳动教育（1-2） Labor Education(1-2)		1	32			3、7	分散	学工部、各院部
	形势与政策（5-8） Situation and Policy(5-8)		-	32			5-8	分散	马克思主义学院、各学院
	数字地形测量实习 Digital Topographic Surveying Practice		3	60	60		2	18-20	测绘工程系
	地图学实习 Cartography Practice		2	40	40		3	17-18	地理信息科学系
	地理信息系统原理实习 GIS Practice		2	40		40	3	19-20	地理信息科学系
	控制测量实习 Practical Training for Control Surveying		2	40	40		4	19-20	测绘工程系
	遥感原理与应用实习 Principles and Applications of Remote Sensing Practice		1	20	20		4	18	遥感工程系
	摄影测量实习 Practical Training for Photogrammetry		1	20	20		5	20	遥感工程系
	卫星导航定位实习 Practical Training for Satellite Navigation and Positioning		1	20	20		5	19	测绘工程系
	自然地理地貌及遥感图像解译实习 Natural Geography and Remote Sensing image interpretation Practice		1	20	20		6	16	遥感工程系
	工程测量综合实习 Comparative Practical Training for Engineering Surveying		4	80	80		6	17-20	测绘工程系
	空间信息综合实习 Spatial Information Practice		5	100	100		7	1-5	测绘学院
	不动产测量与管理实习 Practical Training for Real Estate Surveying and Management		1	20	10	10	7	18	测绘工程系
	激光雷达测量技术实习 Practical Training for Laser Radar Surveying Technology		2	40	20	20	7	19-20	测绘工程系
	毕业设计与毕业答辩 Graduation design and defense		8	160	160		8	1-16	测绘工程系
	小　计		38	872	590	70			
课外	创新实践及科研训练	测绘技能大赛实训 Surveying and Mapping Skills Practice Contest	2	40	40		4	1-10	测绘工程系
		学院测绘技能大赛 School of Surveying and Mapping Skills Contest	1	20	20		4		测绘学院

课程属性	课程名称		学分	折合学时	实验实践	上机	开课学期	开设周次	教学单位
		北斗创新创业大赛 Beidou Innovation and Entrepreneurship Contest	1	20	20				测绘工程系
		全国测绘科技论文大赛 Mostrule Cup-National Paper Contest	1	20	20				测绘学院
		GIS 软件开发大赛实训 GIS Software Development Practice	1	20	20				地理信息科学系
		科研训练 Scientific research training	1	20	20				测绘工程系
	小　计		7	140	140				
实践环节合计 40 学分，课内必修 38 学分，课外（创新实践及科研训练）必修 2 学分									

2020 级测绘工程（专升本）专业本科培养方案

一、专业基本信息

英文名称	Surveying and Mapping Engineering		
专业代码	081201	学科门类	工学
学　　制	2 年	授予学位	工学学士

二、培养目标和专业特色

1.培养目标

培养德、智、体、美、劳全面发展，掌握测绘工程基础理论、基本知识和基本技能，接受科学思维和工程实践训练，具有人文素养、职业道德和社会责任感，胜任国家基础测绘、城乡建设、自然资源监测、地理信息服务及应急管理等领域测绘项目的设计、生产、研发及管理工作，具有较强的组织管理能力、创新意识、继续学习能力、国际视野和城市测绘特色的应用型工程技术人才。

毕业后经过 5 年左右的工作和学习，能够达到如下目标:

（1）能在国家基础测绘、城乡建设、地理信息服务及应急管理等领域胜任工程勘测、设计、施工及管理等方面的测绘技术工作；

（2）具有良好专业素养、丰富的工程管理经验和极强工作责任心，成为测绘地理信息企事业单位中的技术负责人或技术骨干；

（3）具有继续学习适应发展的能力，能够独立或协同承担测绘地理信息科研工作；

（4）具有良好的团队意识、国际化视野和沟通能力，能在设计、生产、研发和多学科团队中担任组织管理骨干或技术负责人角色，具备团队协作精神及领导力；

（5）具有良好的思想道德修养和科学文化素养，具有社会责任感、事业心及良好的职业道德，能够承担和履行社会责任，服务于国家与社会。

2.专业特色

本专业依托首都建设和学校土木建筑类学科优势，培养服务首都、面向全国、依托建筑行业、服务城乡建设的专业测绘人才。人才培养适应测绘高新科技发展，融教学、科研和生产为一体，强调理论与实践密切结合，培养测绘新技术、新方法、新工艺的应用能力，突出城市测绘特色，满足城乡建设、古建筑保护、复杂结构精密测量等测绘人才需求。

三、主干学科

测绘科学与技术

四、主干课程

1．主干课程

GNSS 原理及其应用、摄影测量学、工程测量学、变形监测与灾害预报、不动产测量与管理、激光雷达测量技术与应用。

五、主要实践教学环节

卫星导航定位实习、摄影测量实习、自然地理地貌及遥感图像解译实习、工程测量综合实习、空间信息综合实习、不动产测量与管理实习、激光雷达测量实习。

六、毕业学分要求

参照北京建筑大学本科学生学业修读管理规定及学士学位授予细则，修满本专业最低计划学分应达到 74.5 学分，其中理论课程 49.5 学分，实践教学环节 25 学分(含创新实践及科研训练必修 2 学分)。

七、各类课程结构比例

课程类别	课程属性	学分	学时	学分比例
通识教育课	必修	12	176	16.11%
	选修	2	32	2.68%
专业核心课	必修	10	160	13.42%
专业方向课	必修	6	96	8.05%
	选修	19.5	312	26.17%
独立实践环节	必修	23	460	30.87%
	选修	2	40	2.68%
总计		74.5	1276	100%

八、教学进程表

学期	教学周	考试	实践	学期	教学周	考试	实践
5	1-16 周	17-18 周	19-20 周	6	1-14 周	15 周	16-20 周
7	6-16 周	17 周	1-5 周 18-20 周	8	1-16 毕业设计/实习 17 周答辩		

九、毕业生应具备的知识能力及实现矩阵

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
1.工程知识：能够将数学、自然科学、工程基础和专业知识用于解决复杂测绘工程问题。	1.1 能将数学、自然科学、工程科学的语言工具用于测绘工程问题的表述	土木工程概论、遥感原理与应用、计算机图形学、遥感数字图像处理等。
	1.2 能针对具体的测绘对象建立数学模型并求解	摄影测量学、变形监测与灾害预报。
	1.3 能够将数学、自然科学、工程基础和专业知识以及数学模型方法用于推演、分析复杂测绘工程问题	GNSS 原理及其应用、激光雷达测量技术与应用、计算机图形学、工程测量学、遥感数字图像处理等。

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
	1.4 能够将数学、自然科学、工程基础和专业知识以及数学模型方法用于复杂测绘工程问题解决方案的比较与综合	摄影测量实习、空间信息综合实习、毕业设计等。
2.问题分析：能够应用数学、自然科学和工程科学的基本原理，识别、表达、并通过文献研究分析复杂测绘工程问题，以获得有效结论。	2.1 能运用数学、自然科学和工程科学原理，识别和判断复杂测绘工程问题的关键环节	土木工程概论、变形监测与灾害预报、摄影测量实习、遥感数字图像处理等。
	2.2 能基于数学、自然科学和工程科学原理和数学模型方法正确表达复杂测绘工程问题	测量程序设计大赛实训、激光雷达测量技术与应用、GIS 基础应用技能、工程测量学等。
	2.3 能认识到解决测绘问题有多种方案可选择，会通过文献研究寻求可替代的解决方案	科技文献检索、摄影测量学、大地测量学基础、不动产测量与管理实习等。
	2.4 能运用数学、自然科学和工程科学的基本原理，借助文献研究，分析过程的影响因素，获得有效结论	科技文献检索、GNSS 原理及其应用、控制测量实习、工程测量综合实习、毕业设计、科研训练等。
3.设计/开发解决方案：能够设计针对复杂测绘工程问题的解决方案，设计满足特定需求的测绘系统或测绘生产流程，并能够在设计环节中体现创新意识，考虑社会、健康、安全、法律、文化以及环境等因素。	3.1 掌握测绘工程设计、实施、管理等全流程相关技术，以及测绘地理信息产品的全周期生产方法，了解影响设计目标和技术方案的各种因素	不动产测量与管理、智慧城市导论、摄影测量实习、工程测量综合实习、空间信息综合实习、遥感数字图像处理等。
	3.2 能够针对特定需求，完成测绘系统、生产流程的设计	测量程序设计与数据处理摄影测量实习、GNSS 原理及其应用、激光雷达测量技术与应用、工程测量学、空间信息综合实习等。
	3.3 能够进行测绘系统或测绘生产流程的设计，在设计中体现创新意识	工业测量与数据处理、地理国情监测、创新实践（测绘技能大赛、测绘科技论文大赛）、数字地形测量实习、工程测量综合实习、创新创业类、毕业设计等。
	3.4 在测绘系统或测绘生产流程的设计中能够考虑安全、健康、法律、文化及环境等制约因素	变形监测与灾害预报、创新实践（测绘技能大赛、测绘科技论文大赛）、数字地形测量实习、工程测量综合实习、创新创业类、毕业设计等。

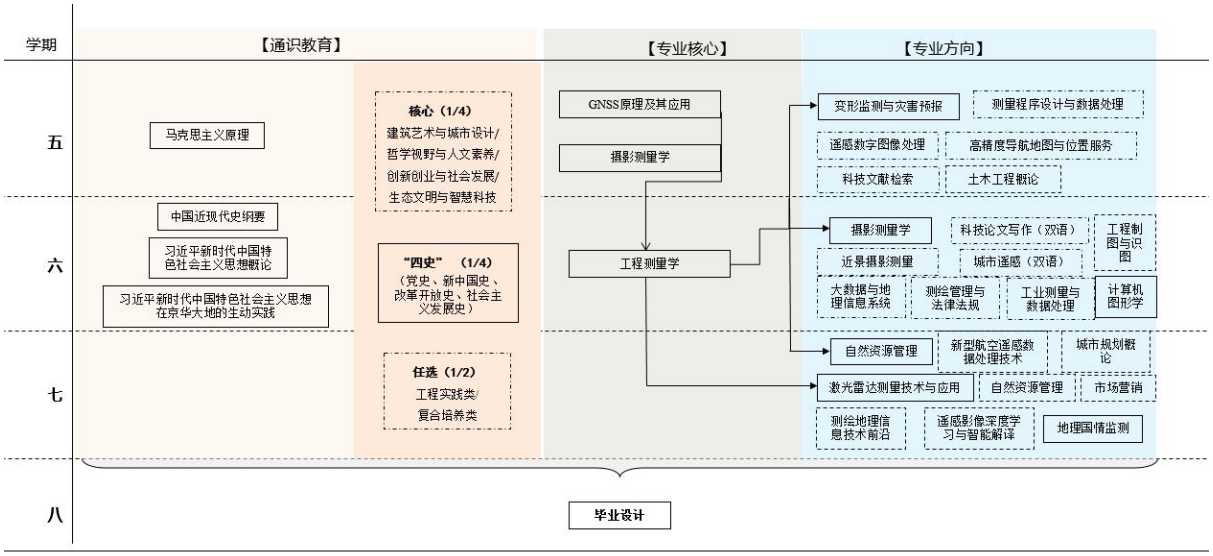
毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
4.研究：能够基于科学原理并采用科学方法对复杂测绘工程问题进行研究，包括设计实验、分析与解释数据、并通过信息综合得到合理有效的结论。	4.1 能够基于科学原理，通过文献研究，采用科学方法，调研和分析复杂测绘工程问题的解决方案	工程测量学、智慧城市导论、地理国情监测、遥感原理实习、地图学实习、卫星导航定位实习等。
	4.2 能够根据测绘对象特征，选择研究路线，设计测绘技术方案	摄影测量学、GNSS 原理及其应用、工程测量综合实习等。
	4.3 能够根据测绘技术方案构建实验系统，安全地开展测绘实验，正确地采集测绘实验数据	测量程序设计与数据处理、工业测量与数据处理、激光雷达测量技术与应用、卫星导航定位实习、测绘技能大赛实训、控制测量实习、激光雷达测量技术实习等。
	4.4 能对实验结果进行分析和解释，并通过信息综合获得合理有效结论	科技文献检索、科技论文写作（双语）、不动产测量与管理实习、激光雷达测量技术实习、空间信息综合实习、测量程序设计大赛实训、毕业设计等。
5.使用现代工具：能够针对复杂测绘工程问题，开发、选择与使用恰当的测绘技术、信息资源、现代测绘仪器和信息技术工具，包括对复杂测绘工程问题的预测与模拟，并能够理解其局限性。	5.1 了解测绘常用的现代测绘仪器、信息技术工具和测绘软件的使用原理和方法，并理解其局限性	工程测量学、激光雷达测量技术与应用、计算机图形学、大数据与地理信息系统、GIS 基础应用技能、不动产测量与管理、智慧城市导论等。
	5.2 能够选择与使用恰当的现代测绘仪器、信息资源和测绘软件，对复杂测绘工程问题进行技术设计、数据处理与精度分析	工程测量学、测量程序设计与数据处理、测量程序设计大赛实训、数字地形测量实习、遥感原理实习、卫星导航定位实习、地理信息系统原理实习、控制测量实习、工程测量综合实习、不动产测量与管理实习、激光雷达测量技术实习、空间信息综合实习、测绘技能大赛实训、毕业设计等。
	5.3 能够针对具体的测绘对象，开发或选用满足特定需求的现代测绘仪器、信息技术工具，对复杂测绘工程问题进行预测与模拟，并能够分析其局限性	科技文献检索、误差理论与测量平差基础、摄影测量实习、毕业设计、创新实践（测绘技能大赛、测绘科技论文大赛）等。
6.工程与社会：能够基于工程相关背景知识进行合理分析，评价测绘工程实	6.1 了解测绘领域的技术标准体系、知识产权、测绘管理政策和法律法规，理解不	土木工程概论、GNSS 原理及其应用、工程测量学、测绘管理与法律法规、工业测量与数据处理、数字地形

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
践和复杂测绘工程问题解决方案对社会、健康、安全、法律以及文化的影响，并理解应承担的责任。	同社会文化对工程活动的影响	测量实习、地理信息系统原理实习、工程测量综合实习、测绘技能大赛实训、工程实践类、毕业设计等。
	6.2 能分析和评价测绘工程实践对社会、健康、安全、法律、文化的影响，以及这些制约因素对工程项目实施的影响，并理解应承担的责任	中国近现代史纲要、马克思主义基本原理、毛泽东思想和中国特色社会主义理论体系概论、不动产管理与测量、测绘管理与法律法规、变形监测与灾害预报、哲学视野与人文素养、创新创业与社会发展、生态文明与智慧科技等。
7.环境和可持续发展：能够理解和评价针对复杂测绘工程问题的测绘工程实践对环境、社会可持续发展的影响。	7.1 知晓和理解环境保护和可持续发展的理念和内涵	遥感数字图像处理、地理国情监测、自然资源管理等。
	7.2 能够从环境保护和可持续发展的角度思考测绘工程实践的可持续性，评价测绘工程实践中可能对人类和环境造成的损害和隐患	市场营销、不动产测量与管理、智慧城市导论、地理国情监测、变形监测与灾害预报、控制测量实习、不动产测量与管理实习、复合培养类、毕业设计等。
8.职业规范：具有人文社会科学素养、社会责任感，能够在测绘工程实践中理解并遵守测绘行业职业道德和规范，履行责任。	8.1 具有正确价值观，理解个人与社会的关系，了解中国国情	中国近现代史纲要、马克思主义基本原理、毛泽东思想和中国特色社会主义理论体系概论等。
	8.2 理解诚实公正、诚信守则的测绘行业职业道德和规范，并能在测绘工程实践中自觉遵守	中国近现代史纲要、测绘地理信息概论、测绘管理与法律法规、数字地形测量实习、不动产测量与管理实习、工程测量综合实习、空间信息综合实习、测绘技能大赛实训等。
	8.3 理解测绘工作人员对公众的安全、健康、福祉、环境保护的社会责任，能够在测绘工程实践中自觉履行责任	马克思主义原理、变形监测与灾害预报、测绘管理与法律法规、毕业设计等。
9.个人和团队：能够在建筑、土木等学科背景下的团队中承担个体、团队成员以及负责人的角色。	9.1 能与建筑、土木等学科的成员有效沟通，合作共事	土木工程概论、城市规划概论、工程测量学、工程测量综合实习、毕业设计等。
	9.2 能够在团队中独立或合作开展工作	创新实践（测绘技能大赛、测绘科技论文大赛）、数字地形测量实习、遥感原理实习、控制测量实习、激光雷达测量技术实习、测绘技能大赛实

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
		训、GIS 软件开发大赛实训等。
	9.3 能够组织、协调和指挥团队开展工作	中国近现代史纲要、控制测量实习、空间信息综合实习、激光雷达测量技术实习、测绘技能大赛实训、毕业设计等。
10.沟通：能够就复杂测绘工程问题与测绘同行及社会公众进行有效沟通和交流，包括撰写测绘技术设计书和测绘技术总结等、陈述发言、清晰表达或回应指令，并具备一定的国际视野，能够在跨文化背景下进行沟通和交流。	10.1 能就测绘专业问题，在测绘技术设计书、测绘技术总结等书面表述以及陈述发言中，准确表达观点，回应质疑，理解与测绘同行及社会公众交流的差异性	地图学实习、控制测量实习、卫星导航定位实习、工程测量综合实习、毕业设计等。
	10.2 了解测绘专业领域的国际发展趋势、研究热点，理解和尊重不同文化的差异性和多样性	空间信息综合实习、现代测绘技术应用、GIS 基础应用技能、遥感应用前景等。
	10.3 具备跨文化交流的语言和书面表达能力，能就测绘专业问题，在跨文化背景下进行基本沟通和交流	科技论文写作（双语）、工程实践类、复合培养类、第二课堂跨文化学分要求（参与国际会议、展览及志愿者等）等。
11.项目管理：理解并掌握工程管理原理与经济决策方法，并能在测绘、建筑、土木、环境等学科环境中应用。	11.1 掌握工程项目中涉及的管理与经济决策方法	测绘管理与法律法规、市场营销、不动产测量与管理、控制测量实习、毕业设计等。
	11.2 了解测绘工程及测绘产品生产的全流程成本构成，理解其中涉及的工程管理与经济决策问题	市场营销、测绘管理与法律法规、空间信息综合实习、毕业设计等。
	11.3 能在土木、建筑等学科环境下，在设计开发测绘方案的过程中，运用工程管理与经济决策方法	土木工程概论、工程测量综合实习、不动产测量与管理实习、城市规划概论、毕业设计等。
12.终身学习：具有自主学习和终身学习的意识，有不断学习和适应发展的能力。	12.1 能在社会发展的大背景下，认识到自主学习和终身学习的必要性	误差理论与测量平差基础、测绘管理与法律法规、测绘地理信息技术前沿等。
	12.2 具有自主学习和适应发展的能力，包括对测绘技术问题的理解能力，归纳总结的能力和提出问题的能力等。	马克思主义基本原理、科技论文写作（双语）、智慧城市导论、人工智能在地理信息系统中的应用、毕业设计、创新实践（测绘技能大赛、测绘科技论文大赛）等。

十、指导性教学计划（见附表）

十一、主要课程逻辑关系结构图



2020 Undergraduate Program for Specialty in Surveying and Mapping Engineering （Associate Degree to Bachelor Degree）

I Specialty Name and Code

English Name	**Surveying and Mapping Engineering**		
Code	081201	Disciplines	Engineering
Length of Schooling	Four years	Degree	Bachelor of Engineering

II Educational Objectives and Features

1.Objectives

This program is to cultivate all-round development of morality, intelligence, physique, beauty and labor, master the basic theory, basic knowledge and basic skills of Surveying and mapping engineering, accept the training of scientific thinking and engineering practice, have humanistic quality, professional ethics and social responsibility, and be competent for the design, production and research of Surveying and mapping projects in national basic surveying and mapping, urban and rural construction, natural resource monitoring, geographic information service and emergency management Development and management, with strong organization and management ability, innovation consciousness, continuous learning ability, international vision and urban surveying and mapping characteristics of Applied Engineering and technical personnel. After five years of work and study after graduation, students can achieve the following goals:

(1) Capable of Surveying and mapping technology in national basic surveying and mapping, urban and rural construction, geographic information service and emergency management, etc;

(2) With good professional quality, rich engineering management experience and strong sense of responsibility, he has become the technical director or technical backbone of Surveying and mapping geographic information enterprises and institutions;

(3) Have the ability to continue learning to adapt to the development, and be able to independently or cooperatively undertake the scientific research of Surveying and mapping geographic information;

(4) Have good team consciousness, international vision and communication ability, be able to play the role of organizational management backbone or technical director in design, production, R & D and multidisciplinary teams, with team spirit and leadership;

(5) With good ideological and moral cultivation and scientific and cultural literacy, with a sense of social responsibility, dedication and good professional ethics, can undertake and perform social responsibility, serve the country and society.

2. Features

Relying on the advantages of capital construction and civil architecture discipline, this major cultivates professional surveying and mapping talents serving the capital, facing the whole country, relying on the construction industry and serving urban and rural construction. Personnel training adapts to the

development of high-tech surveying and mapping, integrates teaching, scientific research and production, emphasizes the close combination of theory and practice, cultivates the application ability of new technology, new method and new process of Surveying and mapping, highlights the characteristics of Urban Surveying and mapping, and meets the needs of Surveying and mapping talents such as urban and rural construction, protection of ancient buildings and precise measurement of complex structures.

III Major Disciplines

Science and Technology of Surveying and Mapping

IV Major Courses

1. Basic Courses

Introduction to Geomatics, Engineering Drawing and Read Drawing, C Language Programming Design, Data Structure, Introduction to Earth Science, Digital Topographic Surveying, Cartography, CAD Basic and Application, Fundamentals of Error Theory and Surveying Adjustment, Foundation of Geodesy, The Principle of Geographic Information System (Bilingual), Application and Principles of Remote Sensing, Photogrammetry.

2. Specialty Courses

Application and Principles of GNSS, Engineering Surveying, Deformation Monitoring and Disasters Predicting, Real Estate Surveying and Management, Application and Technology of Laser Radar Surveying.

V Major Practical Training

1. Major experiment

Experiment of Digital Topographic Surveying, Experiment of Satellite Navigation and Positioning Technology, Experiment of Photogrammetry, Experiment of GIS Principles, Experiment of Geodesy, Experiment of Engineering Surveying, Experiment of Deformation Monitoring, Experiment of Real Estate Surveying and Management, Experiment of Application and Technology of Laser Radar Surveying.

2. Major Practical Training

Digital Topographic Surveying Practice, Satellite Navigation and Positioning Practice, Principles of Remote Sensing Practice, Photogrammetry Practice, GIS Practice, Cartography Practice, Control Surveying Practice, Interpretation of Physical Geography,Geomorphology and Remote Sensing Image Practice, Comprehensive Training for Engineering Surveying, Comprehensive Training for Spatial Information, Real Estate Surveying and Management Practice, Laser Radar Surveying Practice.

VI Graduation Requirements

In accordance with "Management Regulations for the Undergraduate Students of Beijing University of Civil Engineering and Architecture" and "Bachelor's Degree Awarding Regulations", the minimum credits

required by specialty for graduate is 74.5, including 49.5 credits of theoretical courses and 25 credits of practice teaching (2 credits of compulsory innovation practice and scientific research training included).

VII Proportion of Course

Course Category	Course Type	Credits	Class Hour	Proportion
General Education	Compulsory	12	176	16.11%
	Optional	2	32	2.68%
Professional Core	Compulsory	10	160	13.42%
Professional Direction	Compulsory	6	96	8.05%
	Optional	19.5	312	26.17%
Practice	Compulsory	23	460	30.87%
	Optional	2	40	2.68%
Total		74.5	1276	100%

VIII. Table of Teaching Program

Semester	Teaching	Exam	Practice	Semester	Teaching	Exam	Practice
5	1-16	17-18	19-20	6	1-14	15	16-20
7	6-16	17	1-5 18-20	8	1-16 graduation project 17 defense		

IX. Graduate Abilities and Matrices

Graduate Abilities	Related Knowledge	Course Supports
1. Engineering knowledge: Be able to use mathematics, natural science, engineering foundation and professional knowledge to solve complex surveying and mapping engineering problems.	1.1 Be able to use the language tools of mathematics, natural science and engineering science to express surveying and mapping engineering problems	Computer Graphics、Remote Sensing Digital Image Processing.
	1.2 Be able to establish mathematical model and solve for specific surveying and mapping objects	Photogrammetry、Deformation Monitoring and Disasters Predicting、Foundation of Geodesy、Fundamentals of Error Theory and Surveying Adjustment.
	1.3 Be able to use mathematics, natural science, engineering foundation and professional knowledge as well as mathematical model method to deduce and analyze complex surveying and mapping engineering problems	Application and Principles of GNSS、Application and Technology of Laser Radar Surveying、Computer Graphics、Engineering Surveying、Remote Sensing、 Digital Image Processing.

Graduate Abilities	Related Knowledge	Course Supports
	1.4 Can use mathematics, natural science, engineering foundation and professional knowledge as well as mathematical model method to compare and synthesize the solutions of complex surveying and mapping engineering problems	Photogrammetry Practical、Comprehensive Practice for Spatial Information、Graduation design.
2. Problem analysis: Be able to apply the basic principles of mathematics, natural science and engineering science to identify, express and analyze complex surveying and mapping engineering problems through literature research, so as to obtain effective conclusions.	2.1 Be able to identify and judge the key links of complex surveying and mapping engineering problems by using the principles of mathematics, natural science and engineering science	Deformation Monitoring and Disasters Predicting、Photogrammetry Practice、Remote Sensing Digital Image Processing..
	2.2 Be able to correctly express complex surveying and mapping engineering problems based on the principles of mathematics, natural science and Engineering Science and mathematical model	Surveying Program Design Practice Contest、Application and Technology of Laser Radar Surveying、GIS base Application Skill、Engineering Surveying.
	2.3 Can realize that there are many solutions to solve the problem of Surveying and mapping, and will seek alternative solutions through literature research	Photogrammetry、Engineering Surveying、Practical Training for Real Estate Surveying and Management.
	2.4 Can use the basic principles of mathematics, natural science and Engineering Science, with the aid of literature research, analyze the influencing factors of the process, and obtain effective conclusions	Document Retrieval of Science and Technology、Application and Principles of GNSS、Practical Training for Control Surveying、Practical Training for Engineering Surveying、Graduation design、Scientific research training.
3. Design/Develop solutions: Be able to design solutions for complex surveying and mapping engineering problems, design surveying and mapping system or surveying and	3.1 Master the technology related to the whole process of Surveying and mapping engineering design, implementation and management, as well as the full cycle production method of Surveying and mapping geographic information products, and	Real Estate Surveying and Management、Introduction to Smart City、Engineering Surveying、Practical Training for Photogrammetry、Practical Training for Engineering Surveying、Comprehensive Practice for Spatial Information、Remote Sensing Digital Image Processing..

Graduate Abilities	Related Knowledge	Course Supports
mapping production process to meet specific needs, reflect innovation consciousness in the design process, and consider factors such as society, health, safety, law, culture and environment.	understand various factors affecting the design objectives and technical solutions	
	3.2 Be able to complete the design of Surveying and mapping system and production process according to specific requirements	Photogrammetry Practice、Application and Principles of GNSS、Application and Technology of Laser Radar Surveying、Engineering Surveying、Comprehensive Practice for Spatial Information、Surveying Program Design Practice Contest.
	3.3 Be able to design the surveying and mapping system or production process, and embody the innovation consciousness in the design	Engineering Surveying、Geographic Conditions Monitoring、Invocation Practice(School of Surveying and Mapping Skills Contest、School of Surveying and Mapping Paper Contest)、Digital Topographic Surveying Practice、Practical Training for Engineering Surveying、Innovation and Entrepreneurship、Graduation design.
	3.4 In the design of Surveying and mapping system or mapping production process, the constraints of safety, health, law, culture and environment can be considered	Invocation Practice(School of Surveying and Mapping Skills Contest、School of Surveying and Mapping Paper Contest)、Digital Topographic Surveying Practice、Practical Training for Engineering Surveying、Innovation and Entrepreneurship、Graduation design.
4. Research: Based on scientific principles and scientific methods, it can study complex surveying and mapping engineering problems, including designing experiments, analyzing and interpreting data, and obtaining reasonable and effective conclusions	4.1 Based on scientific principles, through literature research, using scientific methods, research and analyze the solutions of complex surveying and mapping engineering problems	Engineering Surveying、Introduction to Smart City、Geographic Conditions Monitoring、Practical Training for Remote Sensing Princples、Cartography Practice、Practical Training for Satellite Navigation and Positioning.
	4.2 According to the characteristics of Surveying and mapping objects, the research route can be selected and the technical scheme of Surveying and	Engineering Drawing and Interpreting、Application and Principles of Remote Sensing、Photogrammetry、Application and Principles of GNSS、Practical

Graduate Abilities	Related Knowledge	Course Supports
through information synthesis.	mapping can be designed	Training for Engineering Surveying.
	4.3 It can construct the experimental system according to the technical scheme of Surveying and mapping, carry out the surveying and mapping experiment safely, and collect the surveying and mapping experimental data correctly	Surveying Program Design and Data Processing、Industry Surveying and Data Processing、Application and Technology of Laser Radar Surveying、Practical Training for Satellite Navigation and Positioning、Practical Training for Control Surveying、Practical Training for Laser Radar Surveying. Technology.
	4.4 The experimental results can be analyzed and explained, and reasonable and effective conclusions can be obtained through information synthesis	Document Retrieval of Science and Technology、Cartography、Scientific Paper Writing、Engineering Surveying、Practical Training for Real Estate Surveying and Management、Practical Training for Laser Radar Surveying Technology、Comprehensive Practice for Spatial Information、Graduation design.
5. Using modern tools: Be able to develop, select and use appropriate surveying and mapping technology, information resources, modern surveying and mapping instruments and information technology tools, including prediction and Simulation of complex surveying and mapping engineering problems, and understand their limitations.	5.1 Understand the principles and methods of modern surveying and mapping instruments, information technology tools and mapping software commonly used in surveying and mapping, and understand their limitations	Application and Technology of Laser Radar Surveying、Computer Graphics、Big Data an GIS、GIS base Application Skill、Real Estate Surveying and Management、Introduction to Smart City.
	5.2 Be able to select and use appropriate modern surveying and mapping instruments, information resources and surveying and mapping software to carry out technical design, data processing and accuracy analysis for complex surveying and mapping engineering problems	Practical Training for Satellite Navigation and Positioning、GIS Practice、Practical Training for Control Surveying、Comparative Practical Training for Engineering Surveying、Practical Training for Real Estate Surveying and Management、Practical Training for Laser Radar Surveying Technology、Comprehensive Practice for Spatial Information、Graduation design、Surveying and Mapping Skills Practice

Graduate Abilities	Related Knowledge	Course Supports
		Contest.
	5.3 It can develop or select modern surveying and mapping instruments and information technology tools to meet specific needs for specific surveying and mapping objects, predict and simulate complex surveying and mapping engineering problems, and analyze their limitations	Document Retrieval of Science and Technology、Surveying Program Design and Data Processing、Practical Training for Photogrammetry、Graduation design、Invocation Practice(School of Surveying and Mapping Skills Contest、School of Surveying and Mapping Paper Contest).
6. Engineering and Society: Be able to make reasonable analysis based on engineering related background knowledge, evaluate the impact of Surveying and mapping engineering practice and complex surveying and mapping engineering problem solutions on society, health, safety, law and culture, and understand the responsibilities that should be undertaken.	6.1 Understand the technical standard system, intellectual property rights, surveying and mapping management policies, laws and regulations in the field of Surveying and mapping, and understand the influence of different social cultures on engineering activities	Application and Princples of GNSS、Surveying Management and Laws、Digital Topographic Surveying Practice、GIS Practice、Comparative Practical Training for Engineering Surveying、Engineering practice class、Graduation design.
	6.2 Be able to analyze and evaluate the impact of Surveying and mapping engineering practice on society, health, safety, law and culture, as well as the impact of these constraints on the implementation of engineering projects, and understand the responsibilities that should be borne	The Outline of the Modern Chinese History、The Generality of Basic Principle of Marxism、Engineering Surveying、Real Estate Surveying and Management、Surveying Management and Laws、Deformation Monitoring and Disasters Predicting、Classical appreciation and cultural inheritance、Scientific and technological revolution and social development、Ecological civilization and future cities.
7.Environment and sustainable development : Be able to understand and evaluate the impact of complex surveying and mapping engineering practice on the environment and	7.1 Know and understand the concept and connotation of environmental protection and sustainable development	Geographic Conditions Monitoring、Natrual Resources Management、Situation and Policy(1-4).
	7.2 From the perspective of environmental protection and sustainable development, we can think about the sustainability of Surveying and mapping engineering practice, and	Marketing Management、Real Estate Surveying and Management、Introduction to Smart City、Geographic Conditions Monitoring、Deformation Monitoring and Disasters Predicting、

Graduate Abilities	Related Knowledge	Course Supports
social sustainable development.	evaluate the damage and hidden danger that may be caused to human and environment in the practice of Surveying and mapping engineering	Practical Training for Control Surveying、Practical Training for Real Estate Surveying and Management、Compound culture class、Graduation design.
8. Occupational norms: With humanities and social science literacy, social responsibility, can understand and abide by the professional ethics and norms of Surveying and mapping industry in the practice of Surveying and mapping, and fulfill the responsibility.	8.1 Have correct values, understand the relationship between individuals and society, and understand China's national conditions	The Outline of the Modern Chinese History、The Generality of Basic Principle of Marxism、
	8.2 Understand the professional ethics and norms of the surveying and mapping industry of honesty, justice and integrity, and consciously abide by them in the practice of Surveying and mapping projects	Thought Morals Accomplishment and Basic Law、The Outline of the Modern Chinese History、Surveying Management and Laws、Situation and Policy(1-4)、Digital Topographic Surveying Practice、Practical Training for Real Estate Surveying and Management、Comprehensive Practice for Spatial Information.
	8.3 Understand the social responsibility of Surveying and mapping workers for public safety, health, well-being and environmental protection, and be able to consciously perform their responsibilities in surveying and mapping engineering practice	The Generality of Basic Principle of Marxism、Surveying Management and Laws、Graduation design.
9. Individuals and teams: Be able to play the role of individual, team member and leader in the team under the background of architecture, civil engineering and other disciplines.	9.1 Be able to communicate effectively with members of architecture, civil engineering and other disciplines	Engineering Mechanics、Conspectus of Urban Planning、Surveying Program Design and Data Processing and、Graduation design.
	9.2 Ability to work independently or cooperatively in a team	Invocation Practice(School of Surveying and Mapping Skills Contest、School of Surveying and Mapping Paper Contest)、Digital Topographic Surveying Practice、Practical Training for Remote Sensing Principles、Practical Training for Satellite Navigation and Positioning、Practical Training for Control Surveying、Practical

Graduate Abilities	Related Knowledge	Course Supports
		Training for Engineering Surveying、Practical Training for Laser Radar Surveying Technology、GIS Software Development Practice.
	9.3 Ability to organize, coordinate and direct the work of the team	The Outline of the Modern Chinese History、Comprehensive Practice for Spatial Information、Practical Training for Laser Radar Surveying Technology、Surveying and Mapping Skills Contest Practice、Graduation design.
10. Communication: Be able to effectively communicate and communicate with surveying and mapping peers and the public on complex surveying and mapping engineering problems, including writing surveying and mapping technology design book and surveying and mapping technology summary, making statements, clearly expressing or responding to instructions, and having a certain international vision, and being able to communicate and exchange in cross-cultural background.	10.1 Be able to accurately express opinions, respond to queries, and understand the differences of communication with surveying and mapping peers and the public in written statements and statements on surveying and mapping technology design book and survey technology summary	Practical Training for Control Surveying、Comparative Practical Training for Engineering Surveying、Graduation design.
	10.2 Understand the international development trends and research hotspots in the field of Surveying and mapping, and understand and respect the differences and diversity of different cultures	Comprehensive Practice for Spatial Information、GIS base Application Skill、Remote Sensing Application Prospect.
	10.3 Have the ability of cross-cultural communication language and written expression, and be able to carry out basic communication and exchange on surveying and mapping professional issues under the cross-cultural background	Scientific Paper writing、Compound Training、Cross-cultural credit requirements for the second classroom (participation in international conferences, exhibitions and volunteers, etc.).
11. Project management:	11.1 Master the management and economic decision-making methods	Introduction to Civil Engineering、Marketing Management、Real Estate

Graduate Abilities	Related Knowledge	Course Supports
Understand and master the principles of engineering management and economic decision-making methods, and can be applied in surveying and mapping, architecture, civil engineering, environment and other disciplines.	involved in the project	Surveying and Management、Digital Topographic Surveying Practice、Practical Training for Control Surveying、Comparative Practical Training for Engineering Surveying、Graduation design.
	11.2 Understand the whole process cost composition of Surveying and mapping engineering and production of Surveying and mapping products, and understand the engineering management and economic decision-making problems involved	Marketing Management、Surveying Management and Laws、Practical Training for Spatial Information、Graduation design.
	11.3 Under the environment of civil engineering, architecture and other disciplines, in the process of designing and developing surveying and mapping scheme, the method of engineering management and economic decision-making can be used	Comparative Practical Training for Engineering Surveying、Practical Training for Real Estate Surveying and Management、Conspectus of Urban Planning、Graduation design.
12. Lifelong learning: Have the consciousness of self-learning and lifelong learning, and have the ability of continuous learning and adapting to development.	12.1 Under the background of social development, we can realize the necessity of self-learning and lifelong learning	Fundamentals of Error Theory and Surveying Adjustment、Surveying Management and Laws、Advanced Technology of Surveying.
	12.2 Have the ability of self-learning and adapting to development, including the ability to understand the surveying and mapping technical problems, the ability to summarize and the ability to ask questions.	The Generality of Basic Principle of Marxism、Scientific Paper Writing、Introduction to Smart City、Application of Artificial Intelligence in GIS、Graduation design、Invocation Practice(School of Surveying and Mapping Skills Contest、School of Surveying and Mapping Paper Contest).

X Table of Teaching Arrangement (appendix table)

表 1　测绘工程（专升本）专业指导性教学计划（1）

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
通识教育课	必修	马克思主义基本原理★ Basic Principle of Marxism	3	48	48					5	马克思主义学院
		中国近现代史纲要 The Outline of the Modern Chinese History	3	48	32			16		6	马克思主义学院
		习近平新时代中国特色社会主义思想概论 Introduction to Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era	3	48	48					6	马克思主义学院
		习近平新时代中国特色社会主义思想在京华大地的生动实践 The Vivid Practice of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era in Beijing	0.5	8	8					6	马克思主义学院
		“四史”（党史、新中国史、改革开放史、社会主义发展史） History of the Communist Party of China, History of New China, History of Reform and Opening up and History of Socialist Development	0.5	8	8					5-7	马克思主义学院
	核心	建筑艺术与城市设计	2	32						5-8	各院部
		哲学视野与人文素养	2	32						5-8	各院部
		创新创业与社会发展	2	32						5-8	各院部
		生态文明与智慧科技	2	32						5-8	各院部
		至少修读 1 类 2 学分									
	任选	工程实践类	5-8 学期任选								各院部
		复合培养类	5-8 学期任选								各院部
		至少修读 1 门									
	通识教育课合计至少修读 14 学分，其中通识教育必修 10 学分（含“四史”（党史、新中国史、改革开放史、社会主义发展史），四选一，5-7 学期内任意学期完成，0.5 学分），核心 2 学分，任选 2 学分										

表 1　测绘工程（专升本）专业指导性教学计划（2）

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
专业核心课	必修	GNSS 原理及其应用★ The Application and Principles of GNSS	3	48	44	4				5	测绘工程系
		摄影测量学★ Photogrammetry	3	48	40	8				5	遥感工程系
		工程测量学★ Engineering Surveying	4	64	56	8				6	测绘工程系
		小计	10	160	140	20					
	专业核心课合计必修 16 学分										
专业方向课	必修	变形监测与灾害预报 Deformation Monitoring and Disasters Predicting	2	32	24	8				5	测绘工程系
		不动产测量与管理 Real Estate Surveying and Management	2	32	28	4				7	测绘工程系
		激光雷达测量技术与应用 The Application and Technology of Laser Radar Surveying	2	32	24	8				7	测绘工程系
		小　计	6	96	76	20					
	选修	遥感数字图像处理 Remote Sensing Digital Image Processing	2	32	24	8				5	遥感工程系
		科技文献检索 Document Retrieval of Science and Technology	1	16	16			8		5	图书馆
		高精度导航地图与位置服务（限选） High-Precision Navigation Map and Location Service	2	32	32					5	测绘工程系
		土木工程概论(限选)Introduction to Civil Engineering	3	48	48					5	土木学院
		测量程序设计与数据处理（限选）Surveying Data Processing and Programming	2	32	32					5	测绘工程系
		工程制图与识图 （限选） Engineering Drawing and Interpreting	2	32	32					6	理学院
		测绘管理与法律法规（限选） Surveying Management and Laws	1	16	16					6	测绘工程系
		计算机图形学（限选） Computer Graphics	2	32	24	8				6	地理信息科学系
		工业测量与数据处理（限选） Industry Surveying and Data Processing	1.5	24	24					6	测绘工程系
		城市遥感（双语）（限选） Urban Remote Sensing	1.5	24	16	8				6	遥感工程系
		近景摄影测量 Close-range Photogrammetry	2	32	26	6				6	遥感工程系
		大数据与地理信息系统 Big Data and GIS	1.5	24	16	8				6	地理信息科学系
		智慧城市导论 （限选） Introduction to Smart City	1	16	16					6	地理信息科学系
		科技论文写作（双语） Scientific Paper writing	1	16	16					6	测绘工程系
		自然资源管理 Natural Resources Management	1	16	16					7	地理信息科学系
		地理国情监测（限选） Geographic Conditions Monitoring	1.5	24	16	8				7	地理信息科学系
		新型航空遥感数据处理技术 Modern aerial remote sensing data processing technology	2	32	32					7	遥感工程系

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
		遥感影像深度学习与智能解译 Deep learning and intelligent interpretation of remote sensing image	2	32	32					7	遥感工程系
		测绘地理信息技术前沿 Advanced Technology of Surveying, Mapping and GIS	1	16	16					7	测绘学院
		城市规划概论 Conspectus of Urban Planning	1.5	24	20	4				7	建筑学院
		市场营销 Marketing Management	1.5	24	24					7	经管学院
		小 计	40	640	558	82		8			
	专业方向课合计 25.5 学分，必修 6 学分，任选至少修读 19.5 学分										

表 2　测绘工程（专升本）专业指导性教学计划（实践环节）

课程属性	课程名称		学分	折合学时	实验实践	上机	开课学期	开设周次	教学单位
课内	形势与政策（5-8）Situation and Policy(5-8)		-	32			5-8	分散	马院、各学院
	摄影测量实习 Practical Training for Photogrammetry		1	20	20		5	20	遥感工程系
	卫星导航定位实习 Practical Training for Satellite Navigation and Positioning		1	20	20		5	19	测绘工程系
	自然地理地貌及遥感图像解译实习 Natural Geography and Remote Sensing image interpretation Practice		1	20	20		6	16	遥感工程系
	工程测量综合实习 Comparative Practical Training for Engineering Surveying		4	80	80		6	17-20	测绘工程系
	空间信息综合实习 Spatial Information Practice		5	100	100		7	1-5	测绘学院
	不动产测量与管理实习 Practical Training for Real Estate Surveying and Management		1	20	10	10	7	18	测绘工程系
	激光雷达测量技术实习 Practical Training for Laser Radar Surveying Technology		2	40	20	20	7	19-20	测绘工程系
	毕业设计与毕业答辩 Graduation design and defense		8	160	160		8	1-16	测绘工程系
	小　计		23	460	430	30			
课外	创新实践及科研训练	测绘技能大赛实训 Surveying and Mapping Skills Practice Contest	2	40	40		6	1-10	测绘工程系
		学院测绘技能大赛 School of Surveying and Mapping Skills Contest	1	20	20		6		测绘学院
		测量程序设计大赛实训 Surveying Programming Design Practice Contest	1	20	20		5		测绘工程系
		北斗创新创业大赛 Beidou Innovation and Entrepreneurship Contest	1	20	20		5		测绘工程系
		全国论文大赛 Mostrule Cup-National Paper Contest	1	20	20				测绘学院
		GIS 软件开发大赛实训 GIS Software Development Practice	1	20	20				地理信息科学系
		科研训练 Scientific research training	1	20	20				测绘工程系
	小　计		8	160	160				
实践环节合计 25 学分，课内必修 23 学分，课外（创新实践及科研训练）必修 2 学分									

2022 级导航工程（智能导航实验班）专业本科培养方案

一、专业基本信息

英文名称	Navigation Engineering (Intelligent Navigation)		
专业代码	081203T	学科门类	工学
学　　制	4 年	授予学位	工学学士

二、培养目标和专业特色

1.培养目标

培养德、智、体、美、劳全面发展，掌握导航定位基础理论、基本知识和基本技能，接受科学思维和工程及产品实践训练，具有人文素养、职业道德和社会责任感，能在航空、航天、交通、军事、电子、信息、通讯产业及城市基础设施等领域从事导航工程设计与研发及工程管理工作，具有较强的组织管理能力、创新意识、继续学习能力、国际视野和智慧城市智能导航特色的创新应用型工程技术人才。毕业后经过 5 年左右的工作和学习，能够达到如下目标:

（1）具有综合利用导航定位、微电子科学、信息科学和计算机科学等较宽领域的技术，解决导航领域复杂技术难题的能力，系统掌握导航工程设计与研发、导航信息获取、处理、分析、表达与应用等关键环节的专业技术；

（2）具有优秀的专业素养、丰富的工程管理经验和极强工作责任心，成为导航相关企事业单位中的技术负责人或技术骨干；

（3）具有继续学习适应发展的能力，能够独立或协同承担导航工程设计与科研工作；

（4）具有良好的团队组织协调能力、国际化视野和对外的沟通能力，能在航空、航天、交通、军事、电子、信息、通讯产业及城市基础设施等领域组织团队从事导航工程设计与研发工作；

（5）具有良好的科学文化素养和一定的哲学方法论思维，具有服务国家大局意识、社会责任感与历史使命感，具有良好的职业道德与为人民服务的事业心。

2.专业特色

本专业依托首都建设和学校土木建筑类学科优势，培养服务首都、面向全国，具备解决智慧城市智能导航相关问题，能进行导航定位产品研发及集成解决方案设计的高素质专业人才。人才培养适应智能导航高新科技发展，融教学、科研和生产为一体，强调理论与实践密切结合，培养导航定位新技术、新方法、新工艺的应用能力，突出智慧城市智能导航特色，服务于城市建设导航与管理、智能交通、应急管理、互联网、航空航天等领域。

三、主干学科

测绘科学与技术

四、主干课程

1．主干基础课程

测绘地理信息概论、导航工程概论、地球科学概论、C/C++程序设计、导航装备基础、数字地形测量学、摄影测量与遥感原理、误差理论与测量平差基础、自动控制原理、导航学、大地测量学基础、最优估计、数字信号处理、地理信息系统原理等。

2．主干专业课程

卫星导航原理、信号与系统、嵌入式系统与程序设计、导航电子地图、惯性导航原理、组合导航、卫星导航算法与程序设计、室内导航与定位技术、无人驾驶高精地图及应用、机器人导航原理与技术、城市时空大数据技术等。

五、主要实践教学环节

1．主要实验

C/C++程序设计实验、数字地形测量学实验、摄影测量与遥感原理实验、大地测量学基础实验、数字信号处理实验、卫星导航原理实验、信号与系统实验、惯性导航原理实验、组合导航实验、卫星导航算法与程序设计实验、导航电子地图实验、嵌入式系统与程序设计实验、室内导航与定位技术实验、地理信息系统原理实验、机器人导航原理与技术实验、城市时空大数据技术实验等。

2．主要实践环节

数字地形测量实习、导航装备基础实习、数字信号处理实习、测量平差基础实习、自动控制原理实习、大地测量学基础实习、卫星导航原理实习、惯性导航原理实习、组合导航实习、室内导航与定位技术实习、嵌入式系统与程序设计实习、机器人导航原理与技术、无人驾驶高精地图及应用实习、导航电子地图实习、导航定位综合实习、城市时空大数据技术实习等。

六、毕业学分要求

参照北京建筑大学本科学生学业修读管理规定及学士学位授予细则，修满本专业最低计划学分应达到 176 学分，其中理论课程 133 学分，实践教学环节 43 学分(含创新实践及科研训练必修 6 学分)。

七、各类课程结构比例

课程类别	课程属性	学分	学时	学分比例
通识教育课	必修	43.5	736	24.72%
	选修	2	32	1.14%
学科基础课	必修	51.5	884	29.26%
专业核心课	必修	16	256	9.09%
专业方向课	必修	8	128	4.55%
	选修	12	192	6.82%
独立实践环节	必修	37	852	21.02%
	选修	6	120	3.41%
总计		176	3200	100%

八、教学进程表

学期	教学周	考试	实践	学期	教学周	考试	实践
1	4-18 周	19 周	1-3 周、20 周	2	1-15 周	16 周	17-20 周
3	1-16 周	17 周	18-20 周	4	1-15 周	16 周	17-20 周
5	1-16 周	16 周	17-20 周	6	1-15 周	16 周	17-20 周
7	4-18 周	19 周	1-3 周、20 周	8	1-16 毕业设计/实习 17 周答辩		

九、毕业生应具备的知识能力及实现矩阵

本专业毕业要求能完全覆盖认证通用标准的要求

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
1.工程知识：能够将数学、自然科学、工程基础和专业知识用于解决复杂导航工程问题。	1.1 能将数学、自然科学、工程科学的语言工具用于指挥智慧城市导航工程问题的表述	卫星导航算法与程序设计、嵌入式系统与程序设计、计算思维导论、C/C++程序设计、工程制图与识图、概率与数理统计 B、线性代数、土木工程概论、导航学、遥感数字图像处理、地球科学概论、计算机图形学、最优估计、导航电子地图、导航工程概论、数字信号处理等。
	1.2 能针对具体的导航工程对象建立数学模型并求解	线性代数、物理实验（1-2）、数字地形测量学、误差理论与测量平差基础、最优估计、导航装备基础、导航学等。
	1.3 能够将数学、自然科学、工程基础和专业知识以及数学模型方法用于推演、分析复杂导航工程问题	计算思维导论、工程制图与识图、线性代数、误差理论与测量平差基础、最优估计、导航电子地图、地理信息系统原理、遥感数字图像处理、计算机图形学等。
	1.4 能够将数学、自然科学、工程基础和专业知识以及数学模型方法用于复杂导航工程问题解决方案的比较与综合	C/C++程序设计、概率与数理统计 B、导航学、误差理论与测量平差基础、最优估计、导航电子地图、遥感数字图像处理、地理信息系统原理实习、导航装备基础实习、测量平差基础实习、导航定位综合实习、毕业设计与毕业答辩等。
2.问题分析：能够应用数学、自然科学和工程科学的基本原理，识别、表达、并通过文献研究分析复杂导航工程问题，以获得有效结论。	2.1 能运用数学、自然科学和工程科学原理，识别和判断复杂导航工程问题的关键环节	卫星导航算法与程序设计、嵌入式系统与程序设计、计算思维导论、C/C++程序设计、概率与数理统计 B、线性代数、土木工程概论、导航学、地球科学概论、卫星导航定位实习、导航装备基础实习等。

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
	2.2 能基于数学、自然科学和工程科学原理和数学模型方法正确表达复杂导航工程问题	导航电子地图、摄影测量与遥感原理、遥感数字图像处理、数字地形测量学、自动控制原理、室内导航与定位技术、导航学、测量平差基础实习、卫星导航原理实习、导航装备基础实习等。
	2.3 能认识到解决导航工程问题有多种方案可选择，会通过文献研究寻求可替代的解决方案	卫星导航算法与程序设计、嵌入式系统与程序设计、C/C++程序设计、时空人工智能技术、科技文献检索、摄影测量与遥感原理实习、卫星导航原理实习、室内导航与定位技术实习、导航定位综合实习等。
	2.4 能运用数学、自然科学和工程科学的基本原理，借助文献研究，分析过程的影响因素，获得有效结论	高等数学、普通物理、卫星导航原理、惯性导航原理、室内导航与定位技术、科技文献检索、最优估计、毕业设计与毕业答辩、科研团队创新训练等。
3.设计/开发解决方案：能够设计针对复杂导航工程问题的解决方案，设计满足特定需求的导航系统或导航产品生产流程，并能够在设计环节中体现创新意识，考虑社会、健康、安全、法律、文化以及环境等因素。	3.1 掌握智慧城市导航工程设计、实施、管理等全流程相关技术，以及导航产品研发的全周期生产方法，了解影响设计目标和技术方案的各种因素。	卫星导航原理、惯性导航原理、室内导航与定位技术、自动控制原理、计算思维导论、智慧城市导论、导航学、惯性导航原理实习、嵌入式系统与程序设计实习、导航定位综合实习等。
	3.2 能够针对特定需求，完成导航系统、产品研发流程的设计	卫星导航算法与程序设计、嵌入式系统与程序设计、自动控制原理、GNSS 增强技术及应用、城市高精度 GNSS 定位数据处理、GNSS 时频测量及应用、导航装备基础实习、惯性导航原理实习、卫星导航原理实习等。
	3.3 能够进行导航系统或产品研发流程的设计，在设计中体现创新意识	卫星导航算法与程序设计、嵌入式系统与程序设计、数字地形测量学、导航芯片制造概论、导航电子地图实习、无人驾驶高精地图及应用实习、科研团队创新训练、毕业设计与毕业答辩等。
	3.4 在导航系统或产品研发流程的设计中能够考虑安全、健康、法律、文	卫星导航算法与程序设计、嵌入式系统与程序设计、UNIX/LINUX 操作系统、自

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
	化及环境等制约因素	动控制原理、导航产品设计与实现、导航装备基础实习、嵌入式系统与程序设计实习、毕业设计与毕业答辩等。
4.研究：能够基于科学原理并采用科学方法对复杂导航工程问题进行研究，包括设计实验、分析与解释数据、并通过信息综合得到合理有效的结论。	4.1 能够基于科学原理，通过文献研究，采用科学方法，调研和分析复杂导航工程问题的解决方案	卫星导航原理、惯性导航原理、室内导航与定位技术、机器人导航原理与技术、智慧城市导论、高精度地图技术与应用、自动控制原理、最优估计实习、无人驾驶高精地图及应用实习、卫星导航原理实习等。
	4.2 能够根据智慧城市导航对象特征，选择研究路线，设计导航工程技术方案	计算思维导论、导航学、工程制图与识图、卫星导航原理、导航定位综合实习等。
	4.3 能够根据导航工程技术方案构建实验系统，安全地开展导航定位实验，正确地采集导航定位实验数据	误差理论与测量平差基础、最优估计、信号与系统、卫星导航原理实习、导航电子地图实习、城市高精度 GNSS 定位数据处理、GNSS 时频测量及应用等。
	4.4 能对实验结果进行分析和解释，并通过信息综合获得合理有效结论	科技文献检索、城市时空大数据技术、导航电子地图、遥感数字图像处理、科技论文写作（双语）、城市时空大数据技术、毕业设计与毕业答辩等。
5.使用现代工具：能够针对复杂导航工程问题，开发、选择与使用恰当的导航技术、信息资源、现代导航仪器和信息技术工具，包括对复杂导航工程问题的预测与模拟，并能够理解其局限性。	5.1 了解导航领域常用的现代导航仪器、信息技术工具和导航软件系统的使用原理和方法，并理解其局限性	计算思维导论、C/C++程序设计、Verilog VHDL 语言、UNIX/LINUX 操作系统、信号与系统、导航电子地图、遥感数字图像处理、数字地形测量学、计算机图形学、智慧城市导论、导航装备基础实习、PCB 设计与制作、手机室内导航与位置服务等。
	5.2 能够选择与使用恰当的现代导航仪器、信息资源和导航软件系统，对复杂导航工程问题进行技术设计、数据处理与精度分析	工程制图与识图、数字信号处理、信号与系统、视觉导航技术、工业智能定位测量、组合导航实习、导航装备基础实习、惯性导航原理实习、嵌入式系统与程序设计实习、导航电子地图实习、卫星导航原理实习、机器人导航原理与技术实习、毕业设计与毕业答辩、测绘程序设计大赛实训、

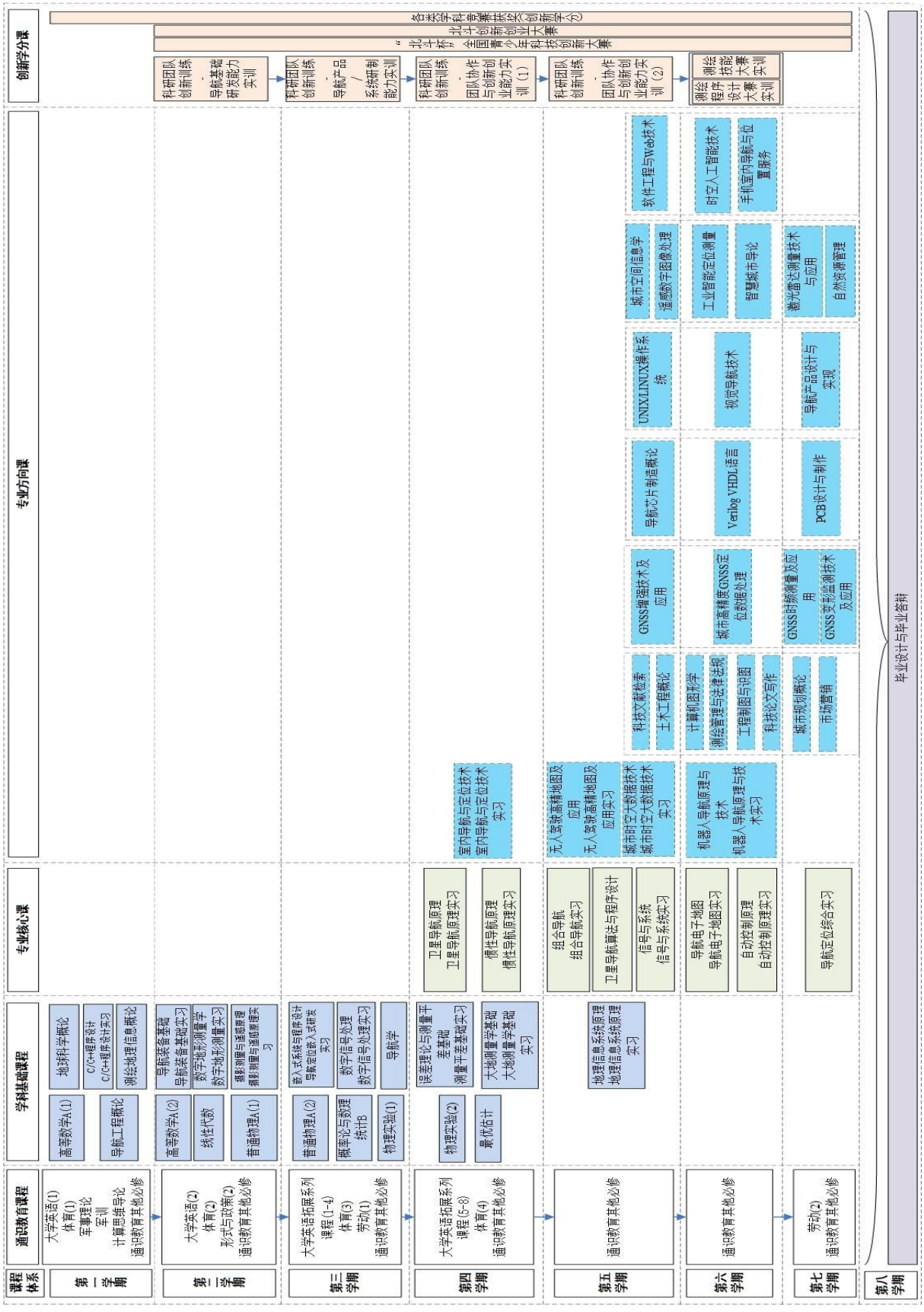
毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
		测绘技能大赛实训等。
	5.3 能够针对具体的智慧城市导航对象，开发或选用满足特定需求的现代导航仪器、信息技术工具，对复杂导航工程问题进行预测与模拟，并能够分析其局限性	概率与数理统计 B、线性代数、自动控制原理、误差理论与测量平差基础、最优估计、GNSS 时频测量及应用、数字信号处理实习、软件工程与 Web 技术、科技文献检索、室内导航与定位技术实习、毕业设计与毕业答辩等。
6.工程与社会：能够基于工程相关背景知识进行合理分析，评价导航工程实践和复杂导航工程问题解决方案对社会、健康、安全、法律以及文化的影响，并理解应承担的责任。	6.1 了解智慧城市导航领域的技术标准体系、知识产权、管理政策和法律法规，理解不同社会文化对工程活动的影响	思想道德与法治、土木工程概论、数字地形测量学、大地测量学基础、城市空间信息学、测绘管理与法律法规、无人驾驶高精地图及应用实习、室内导航与定位技术实习、科研团队创新训练、毕业设计与毕业答辩等。
	6.2 能分析和评价智慧城市导航工程实践对社会、健康、安全、法律、文化的影响，以及这些制约因素对工程项目实施的影响，并理解应承担的责任	中国近现代史纲要、马克思主义基本原理、毛泽东思想和中国特色社会主义理论体系概论、测绘管理与法律法规、城市规划与人文素养、经典研读与文化传承、科技文明与城市发展、建筑艺术与美学素养等。
7.环境和可持续发展：能够理解和评价针对复杂导航工程问题的导航工程实践对环境、社会可持续发展的影响。	7.1 知晓和理解环境保护和可持续发展的理念和内涵	习近平新时代中国特色社会主义思想概论、习近平新时代中国特色社会主义思想在京华大地的生动实践、地球科学概论、智慧城市导论、自然资源管理、形势与政策（1-4）、工程实践类、城市规划概论等。
	7.2 能够从环境保护和可持续发展的角度思考导航工程实践的可持续性，评价导航工程实践中可能对人类和环境造成的损害和隐患	市场营销、地球科学概论、智慧城市导论、城市空间信息学、城市时空大数据技术实习、复合培养类、毕业设计与毕业答辩等。
8.职业规范：具有人文社会科学素养、社会责任感，能够在导航工程实践中理解并遵守测绘行业职业道德和规	8.1 具有正确价值观，理解个人与社会的关系，了解中国国情	思想道德与法治、中国近现代史纲要、马克思主义基本原理、习近平新时代中国特色社会主义思想概论、习近平新时代中国特色社会主义思想在京华大地的生动实

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
范，履行责任。		践、毛泽东思想和中国特色社会主义理论体系概论、体育（1-4）、“四史”（党史、新中国史、改革开放史、社会主义发展史）、军训、军事理论、劳动教育等。
	8.2 理解诚实公正、诚信守则的导航工程行业职业道德和规范，并能在智慧城市导航工程实践中自觉遵守	思想道德与法治、中国近现代史纲要、毛泽东思想和中国特色社会主义理论体系概论、大学生职业生涯与发展规划、测绘管理与法律法规、形势与政策（1-4）、导航定位综合实习等。
	8.3 理解导航工作人员对公众的安全、健康、福祉、环境保护的社会责任，能够在智慧城市导航工程实践中自觉履行责任	马克思主义基本原理、习近平新时代中国特色社会主义思想概论、习近平新时代中国特色社会主义思想在京华大地的生动实践、大学生职业生涯与发展规划、形势与政策（5-8）、地球科学概论、测绘管理与法律法规、GNSS 变形监测技术及应用、毕业设计与毕业答辩等。
9.个人和团队：能够在建筑、土木等多学科背景下的团队中承担个体、团队成员以及负责人的角色。	9.1 能与建筑、土木等多学科的成员有效沟通，合作共事	大学生职业生涯与发展规划、体育(1-4)、土木工程概论、导航工程概论、毕业设计与毕业答辩等。
	9.2 能够在团队中独立或合作开展工作	数字地形测量实习、大地测量学基础实习、导航定位原理实习、导航装备基础实习、组合导航实习、无人驾驶高精地图及应用实习、导航定位综合实习等。
	9.3 能够组织、协调和指挥团队开展工作	中国近现代史纲要、导航定位综合实习、导航装备基础实习、惯性导航原理实习、嵌入式系统与程序设计实习、毕业设计与毕业答辩等。
10.沟通：能够就复杂导航工程问题与导航同行及社会公众进行有效沟通和交流，包括撰写导航工程技术设计书和导航工程技术总结等、陈述发言、清晰表达或回应指令，并具备一定的国际视野，能够在跨文化背景下进行沟通和交流。	10.1 能就导航工程专业问题，在导航工程技术设计书、导航工程技术总结等书面表述以及陈述发言中，准确表达观点，回应质疑，理解与导航同行及社会公众交流的差异性	导航工程概论、组合导航、城市高精度 GNSS 定位数据处理、无人驾驶高精地图及应用、大学生心理健康、毕业设计与毕业答辩等。
	10.2 了解智慧城市导航专业领域的国际发展趋势、研究热点，理解和尊	测绘地理信息概论、导航工程概论、卫星导航原理、惯性导航原理、室内导航与定位技术、复合培养类等。

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
	重不同文化的差异性和多样性	
	10.3 具备跨文化交流的语言和书面表达能力，能就导航专业问题，在跨文化背景下进行基本沟通和交流	科技论文写作（双语）、大学英语拓展系列课程、工程实践类、复合培养类等。
11.项目管理：理解并掌握工程管理原理与经济决策方法，并能在导航、建筑、土木、环境等多学科环境中应用。	11.1 掌握工程项目中涉及的管理与经济决策方法	地球科学概论、土木工程概论、市场营销、毕业设计与毕业答辩等。
	11.2 了解导航工程及产品研发的全流程成本构成，理解其中涉及的工程管理与经济决策问题	导航装备基础、市场营销、测绘管理与法律法规、自然资源管理、毕业设计与毕业答辩等。
	11.3 能在土木、建筑等多学科环境下，在设计开发导航方案的过程中，运用工程管理与经济决策方法	惯性导航、组合导航、城市高精度 GNSS 定位数据处理、无人驾驶高精地图及应用实习、毕业设计与毕业答辩等。
12.终身学习：具有自主学习和终身学习的意识，有不断学习和适应发展的能力。	12.1 能在社会发展的大背景下，认识到自主学习和终身学习的必要性	思想道德与法治、大学生职业生涯与发展规划、大学英语拓展系列课程、测绘管理与法律法规等。
	12.2 具有自主学习和适应发展的能力，包括对智慧城市导航工程技术问题的理解能力，归纳总结的能力和提出问题的能力等。	马克思主义基本原理、毛泽东思想和中国特色社会主义理论体系概论、地球科学概论、科技论文写作（双语）、智慧城市导论、毕业设计与毕业答辩、科研团队创新训练等。

十、指导性教学计划（见表 1~2）

十一、主要课程逻辑关系结构图



2022 Undergraduate Program for Specialty in Navigation Engineering （Intelligent Navigation）

I Specialty Name and Code

English Name	**Navigation Engineering**		
Code	081203T	Disciplines	Engineering
Length of Schooling	Four years	Degree	Bachelor of Engineering

II Educational Objectives and Features

1. Objectives

This program is to cultivate all-round development of morality, intelligence, physique, beauty and labor, master the basic theory, basic knowledge and basic skills of navigation positioning, accept the training of scientific thinking and engineering practice, have humanistic quality, professional ethics and social responsibility, and be competent for the design, production and research and development of aerospace, transportation, military, electronics, information and communication industries and urban infrastructure in areas such as in navigation engineering design and research and development and project management work, with strong organization and management ability, innovation consciousness, continuous learning ability, international vision and intelligent navigation characteristics of Applied Engineering and technical personnel. After five years of work and study after graduation, students can achieve the following goals:

(1) The ability to solve complex technical problems in the field of navigation by making comprehensive use of technology in a wider range of fields such as navigation and positioning, microelectronics science, information science and computer science, and to master systematically the key aspects of navigation engineering design and development, navigation information acquisition, processing, analysis, expression and application of professional technology.

(2) With excellent professional quality, rich engineering management experience and strong sense of responsibility, to become the technical leader or technical backbone in navigation-related enterprises and institutions;

(3) Have the ability to continue learning to adapt to the development, and be able to independently or cooperatively undertake navigation engineering design and scientific research;

(4) Have good team organization and coordination skills, international vision and external communication ability, be able to organize teams to work on navigation engineering design and R&D in the fields of aerospace, transportation, military, electronics, information and communication industries and urban infrastructure.

(5) With good scientific and cultural literacy and certain philosophical and methodological thinking, with a sense of serving the overall national situation, social responsibility and historical mission, with a good professional ethics and a commitment to serving the people.

2. Features

Relying on the advantages of capital construction and civil engineering and architecture of the university, this major aims to cultivate high-quality professionals who serve the capital, face the whole country, have the ability to solve problems related to smart city intelligent navigation, and can carry out navigation and positioning product research and development and integrated solution design. Talent training to adapt to the intelligent navigation of new and high technology development, it is a combination of teaching, scientific research and production, emphasize closely combining theory with practice, cultivate navigation and positioning of new technologies, new methods, new technology application ability, highlight the characteristics of intelligent city intelligent navigation, navigation services in urban construction and management, intelligent transportation, emergency management, Internet, aerospace and other fields.

III Major Disciplines

Science and Technology of Surveying and Mapping

IV Major Courses

1. Basic Courses

Introduction to Geometrics, Introduction to Navigation Engineering, Introduction to Earth Science, C/C++ Programming Design, Foundation of Navigation Equipment, Digital Topographic Surveying, Principles of Photogrammetry and Remote Sensing, Error Theory and Foundation of Surveying Adjustment, Principle of Automatic Control, Navigation, Foundation of Geodesy, Optimal Estimation, Digital Signal Processing.

2. Specialty Courses

Principle of Satellite Navigation, Signals and Systems, Embedded Systems and Programming, Navigation Electronic Map, Principle of Inertial Navigation, Principle of Combined Navigation, Programming for Satellite Navigation and Positioning, Indoor Navigation and Positioning Technology, Driverless High-precise Map and Application, Robot Navigation Principles and Technology, Urban Spatiotemporal Big Data Technology.

V Major Practical Training

1. Major experiment

Experiment of C/C++ Programming Design, Experiment of Foundation of Navigation Equipment, Experiment of Digital Topographic Surveying, Experiment of Digital Signal Processing , Experiment of Foundation of Geodesy, Experiment of Analog and digital circuits, Experiment of Principle of Satellite Navigation, Experiment of Signals and Systems, Experiment of Principle of Inertial Navigation,

Experiment of Principle of Combined Navigation, Experiment of Programming for Satellite Navigation and Positioning, Experiment of Navigation Electronic Map, Experiment of Embedded Systems and Programming, Experiment of Indoor Navigation and Positioning Technology, Experiment of Robot Navigation Principles and Technology, Experiment of Urban Spatiotemporal Big Data Technology.

2. Major Practical Training

Digital Topographic Surveying Practice, Foundation of Navigation Equipment Practice, Foundation of Surveying Adjustment Practice, Digital Signal Processing Practice, Principle of Automatic Control Practice, Foundation of Geodesy Practice, Principle of Satellite Navigation Practice, Principle of Inertial Navigation Practice, Principle of Combined Navigation Practice, Indoor Navigation and Positioning Technology Practice, Indoor Navigation and Positioning Technology Practice, Embedded Systems and Programming Practice, Robot Navigation Principles and Technology Practice, High-precise Map Technology and Application Practice， Navigation Electronic Map Practice, Navigation and Positioning Comprehensive Practice , Urban Spatiotemporal Big Data Technology Practice.

VI Graduation Requirements

In accordance with "Management Regulations for the Undergraduate Students of Beijing University of Civil Engineering and Architecture" and "Bachelor's Degree Awarding Regulations", the minimum credits required by specialty for graduate is 176, including 133 credits of theoretical courses and 43 credits of practice teaching (6 credits of compulsory innovation practice and scientific research training included).

VII Proportion of Course

Course Category	Course Type	Credits	Class Hour	Proportion
General Education	Compulsory	43.5	736	24.72%
	Optional	2	32	1.14%
Big Academic Subjects	Compulsory	51.5	884	29.26%
Professional Core	Compulsory	16	256	9.09%
Professional Direction	Compulsory	8	128	4.55%
	Optional	12	192	6.82%
Practice	Compulsory	37	852	21.02%
	Optional	6	120	3.41%
Total		176	3200	100%

VIII Table of Teaching Program

Semester	Teaching	Exam	Practice	Semester	Teaching	Exam	Practice
1	4-18	19	1-3,20	2	1-15	16	17-20
3	1-16	17	18-20	4	1-15	16	17-20
5	1-16	16	17-20	6	1-15	16	17-20
7	4-18	19	1-3,20	8	1-16 graduation project 17 defense		

IX Graduate Abilities and Matrices

Graduate Abilities	Related Knowledge	Course Supports
1. Engineering knowledge: Be able to use mathematics, natural science, engineering foundation and professional knowledge to solve complex navigation engineering problems.	1.1 Be able to use the language tools of mathematics, natural science and engineering science to express smart city navigation project problems	Programming for Satellite Navigation and Positioning, Embedded Systems and Programming, Introduction to Computational Thinking, C/C++ Programming Design, Engineering Drawing and Interpreting, Theory of Probability and Statistics (B), Linear Algebra, Introduction to Civil Engineering, Navigation, Remote Sensing Digital Image Processing, Introduction to Earth Science, Computer Graphics, Optimal Estimation, Navigation Electronic Map, Introduction to Navigation Engineering, Digital Signal Processing, etc.
	1.2 Be able to establish mathematical model and solve for specific Navigation Engineering objects	Linear Algebra, Physics Experiment (1-2), Digital Topographic Surveying, Error Theory and Adjustment Basis, Optimal Estimation, Foundation of Navigation Equipment, Navigation, etc.
	1.3 Be able to use mathematics, natural science, engineering foundation and professional knowledge as well as mathematical model method to deduce and analyze complex Navigation Engineering problems	Introduction to Computational Thinking, Engineering Drawing and Interpreting, Linear Algebra, Error Theory and Adjustment Basis, Optimal Estimation, Navigation Electronic Map, Principle of Geographical Information System, Remote Sensing Digital Image Processing, Computer Graphics, etc.

Graduate Abilities	Related Knowledge	Course Supports
	1.4 Can use mathematics, natural science, engineering foundation and professional knowledge as well as mathematical model method to compare and synthesize the solutions of complex Navigation Engineering problems	C/C++ Programming Design, Probability and Mathematical Statistics B, Navigation, Error Theory and Adjustment Basis, Optimal Estimation, Navigation Electronic Map, Remote Sensing Digital Image Processing, Principle of Geographic Information System Practice, Navigation Electronic Map, Foundation of Navigation Equipment Practice, Foundation of Surveying Adjustment Practice, Navigation and Positioning Comprehensive Practice, Graduation Design and Defense, etc..
2. Problem analysis: Be able to apply the basic principles of mathematics, natural science and engineering science to identify, express and analyze complex Navigation Engineering problems through literature research, so as to obtain effective conclusions.	2.1 Be able to identify and judge the key links of complex Navigation Engineering problems by using the principles of mathematics, natural science and engineering science	Programming for Satellite Navigation and Positioning, Embedded Systems and Programming, Introduction to Computational Thinking, C/C++ Programming Design, Probability and Mathematical Statistics B, Linear Algebra, Introduction to Civil Engineering, Navigation, Introduction to Earth Science, Satellite Navigation and Positioning Practice，Foundation of Navigation Equipment Practice, etc.
	2.2 Be able to correctly express complex Surveying and Mapping Engineering Navigation Engineering problems based on the principles of mathematics, natural science and engineering science and mathematical model	Navigation Electronic Map, Principles of Photogrammetry and Remote Sensing, Remote Sensing Digital Image Processing, Digital Topographic Surveying, Principle of Automatic Control, Indoor Navigation and Positioning Technology, Navigation, Foundation of Surveying Adjustment Practice, Satellite Navigation and Positioning Practice, Foundation of Navigation Equipment Practice, etc.
	2.3 Can realize that there are many solutions to solve the	Programming for Satellite Navigation and Positioning, Embedded Systems and

Graduate Abilities	Related Knowledge	Course Supports
	problem of Navigation Engineering, and will seek alternative solutions through literature research	Programming, C/C++ Programming Design, Spatiotemporal Artificial Intelligence Technology, Document Retrieval of Science and Technology, Satellite Navigation and Positioning Practice, Indoor Navigation and Positioning Technology, Navigation and Positioning Comprehensive Practice, etc.
	2.4 Can use the basic principles of mathematics, natural science and Engineering Science, with the aid of literature research, analyze the influencing factors of the process, and obtain effective conclusions	Advanced Mathematics, College physics, Principle of Satellite Navigation, Principle of Inertial Navigation, Indoor Navigation and Positioning Technology, Document Retrieval of Science and Technology, Optimal Estimation, Graduation design and defense, Innovation Training Project of Scientific Research Team, etc.
3. Design/Develop solutions: Be able to design solutions for complex Navigation Engineering problems, design navigation system or navigation product production process to meet specific needs, reflect innovation consciousness in the design process, and consider factors such as society, health, safety, law, culture and environment.	3.1 Master the technology related to smart city navigation engineering design, implementation and management, as well as the full cycle production method of Surveying and Mapping Engineering & Navigation products, and understand various factors affecting the design objectives and technical solutions	Principle of Satellite Navigation, Principle of Inertial Navigation, Indoor Navigation and Positioning Technology, Principle of Automatic Control, Introduction to computational thinking, Introduction to smart city, Navigation, Inertial Navigation Principle Practice, Embedded systems and programming Practice, Navigation and Positioning, Embedded Research and Development Practice, Navigation and Positioning Comprehensive Practice, etc.
	3.2 Be able to complete the design of Navigation system and production process according to specific requirements	Programming for Satellite Navigation and Positioning, Embedded Systems and Programming, Principle of Automatic Control, GNSS Enhancement Technology and Application, Urban High Precise GNSS Positioning Data Processing, GNSS Time-frequency Measurement and Application, Foundation of Navigation

Graduate Abilities	Related Knowledge	Course Supports
		Equipment Practice, Inertial Navigation Principle practice, Satellite Navigation and Positioning Practice, etc.
	3.3 Be able to design the Navigation system or production process, and embody the innovation consciousness in the design	Programming for Satellite Navigation and Positioning, Embedded Systems and Programming, Digital Topographic Surveying, Introduction to Navigation Chip Manufacturing, Navigation Electronic Map Practice, High-precise Map Technology and Application Practice, Driverless High Precision Mapping and Application Practice Innovation Training Project of Scientific Research Team, Graduation Design and Defense, etc.
	3.4 In the design of Navigation system or production process, the constraints of safety, health, law, culture and environment can be considered	Embedded System and Programming Design Practice, UNIX/LINUX Operation System, Principle of Automatic Control, Design and Implementation of Navigation Products, Foundation of Navigation Equipment Practice, Navigation and Positioning Embedded Research and Development Practice, Graduation design and defense, etc.
4. Research: Based on scientific principles and scientific methods, it can study complex navigation engineering problems, including designing experiments, analyzing and interpreting data, and obtaining reasonable and effective conclusions through information synthesis.	4.1 Based on scientific principles, through literature research, using scientific methods, research and analyze the solutions of complex navigation engineering problems	Principle of Satellite Navigation, Principle of Inertial Navigation, Indoor Navigation and Positioning Technology, Robot Navigation Principles and Technology, Introduction to smart city, High-precise Map Technology and Application, Driverless High Precision Mapping and Application Practice, Principle of Automatic Control, High-precise Map Technology and Application Practice, Satellite Navigation and Positioning Practice, etc.

Graduate Abilities	Related Knowledge	Course Supports
	4.2 According to the characteristics of Surveying and Mapping Engineering smart city Navigation objects, the research route can be selected and the technical scheme of navigation engineering can be designed	Introduction to Computational Thinking, Navigation Engineering Drawing and Interpreting, Principle of Satellite Navigation, Navigation and Positioning Comprehensive Practice, etc.
	4.3 It can construct the experimental system according to the technical scheme of navigation engineering, carry out the Navigation position experiment safely, and collect the Navigation position experimental data correctly	Error Theory and Foundation of Surveying Adjustment, Optimal Estimation, Signals and Systems, Satellite Navigation and Positioning Practice, Navigation Electronic Map Practice, Urban High Precise GNSS Positioning Data Processing, GNSS Time-frequency Measurement and Application, etc..
	4.4 The experimental results can be analyzed and explained, and reasonable and effective conclusions can be obtained through information synthesis	Document Retrieval of Science and Technology, Urban Spatiotemporal Big Data Technology, Navigation Electronic Map, Remote Sensing Digital Image Processing, Scientific Paper Writing, Urban Spatiotemporal Big Data Technology, Graduation design and defense, etc..
5. Using modern tools: Be able to develop, select and use appropriate navigation technology, information resources, modern navigation instruments and information technology tools, including prediction and Simulation of complex navigation engineering problems, and understand their limitations.	5.1 Understand the principles and methods of modern Navigation instruments, information technology tools and Navigation software commonly used in navigation, and understand their limitations	Introduction to Computational Thinking, C/C++ Programming Design, Verilog VHDL Language, UNIX/LINUX Operation System, Signals and Systems, Navigation Electronic Map, Remote Sensing Digital Image Processing, Digital Topographic Surveying, Computer Graphics, Introduction to smart city, Foundation of Navigation Equipment Practice, PCB Design and Manufacture, Mobile Indoor Navigation and Location Service, etc..

Graduate Abilities	Related Knowledge	Course Supports
	5.2 Be able to select and use appropriate modern Navigation instruments, information resources and Navigation software to carry out technical design, data processing and accuracy analysis for complex Navigation Engineering problems	Engineering Drawing and Interpreting, Digital Signal Processing, Signals and Systems, Visual Navigation Technology, Industrial Intelligent Positioning Survey, Navigation and Positioning Comprehensive Practice, Foundation of Navigation Equipment Practice, Inertial Navigation Principle practice, Embedded Research and Development Practice, Navigation and Positioning Embedded Research and Development Practice, Navigation Electronic Map Practice, Satellite Navigation and Positioning Practice, Robot Navigation Principle and Technology Practice, Graduation design and defense, Surveying Programming Contest Practice, Surveying Skills Contest Practice, etc. .
	5.3 It can develop or select modern Navigation instruments and information technology tools to meet specific needs for Navigation objects, predict and simulate complex Navigation problems, and analyze their limitations	Theory of Probability and Statistics (B), Linear Algebra, Principle of Automatic Control, Error Theory and Foundation of Surveying Adjustment, Optimal Estimation, GNSS Time-frequency Measurement and Application, Digital Signal Processing practice, Software Engineering and Web Technology, Document Retrieval of Science and Technology, Indoor Navigation and Positioning Technology Practice, Graduation Design and Defense, etc. .
6. Engineering and Society: Be able to make reasonable analysis based on engineering related background knowledge, evaluate the impact of	6.1 Understand the technical standard system, intellectual property rights, surveying and mapping management policies, laws and regulations in the field of smart city navigation, and	Ideological Morality and Rule of Law, Introduction to Civil Engineering, Digital Topographic Surveying, Foundation of Geodesy Practice, Urban Spatial Information Science, Surveying Management and Laws, Driverless High

Graduate Abilities	Related Knowledge	Course Supports
Navigation engineering practice and complex Navigation engineering problem solutions on society, health, safety, law and culture, and understand the responsibilities that should be undertaken.	understand the influence of different social cultures on engineering activities	Precision Mapping and Application Practice, Indoor navigation and Positioning Technology, Navigation and Positioning Practice, Innovation Training Project of Scientific Research Team, Compound culture class, Graduation design and defense, etc.
	6.2 Be able to analyze and evaluate the impact of Navigation engineering practice on society, health, safety, law and culture, as well as the impact of these constraints on the implementation of engineering projects, and understand the responsibilities that should be borne	The Outline of the Modern Chinese History, The Generality of Basic Principle of Marxism, Introduction to Mao Zedong Thoughts and Theoretical System of socialism with Chinese characteristics, Surveying Management and Laws, Urban planning and humanistic literacy, Classics study and cultural inheritance, Scientific and technological civilization and urban development, Architectural art and aesthetic quality, etc.
7. Environment and sustainable development : Be able to understand and evaluate the impact of complex navigation engineering practice on the environment and social sustainable development.	7.1 Know and understand the concept and connotation of environmental protection and sustainable development	Introduction to Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, Introduction to Earth Science, Introduction to Smart City, Geographic Conditions Monitoring, Situation and Policy (1-4), Engineering Practice, Marketing Management, etc..
	7.2 From the perspective of environmental protection and sustainable development, we can think about the sustainability of Navigation engineering practice, and evaluate the damage and hidden danger that may be caused to human and environment in the practice of navigation engineering	Marketing Management, Introduction to Earth Science, Introduction to smart city, Urban Spatial Information Science, Urban Spatiotemporal Big Data Technology Practice, Urban Spatiotemporal Big Data Technology, Compound Culture Class, Graduation Design and Defense, etc.

Graduate Abilities	Related Knowledge	Course Supports
8. Occupational norms: With humanities and social science literacy, social responsibility, can understand and abide by the professional ethics and norms of Navigation engineering industry in the practice of Navigation engineering, and fulfill the responsibility.	8.1 Have correct values, understand the relationship between individuals and society, and understand China's national conditions	Ideological Morality and Rule of Law, The Outline of the Modern Chinese History, The Generality of Basic Principle of Marxism, Introduction to Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, Introduction to Mao Zedong Thoughts and Theoretical System of socialism with Chinese characteristics, Physical Education(1-4), History of the Communist Party of China, History of New China, History of Reform and Opening up and History of Socialist Development, Military Training, Military Theory, Labor Education, etc. .
	8.2 Understand the professional ethics and norms of the navigation engineering industry of honesty, justice and integrity, and consciously abide by them in the practice of Navigation projects	Ideological Morality and Rule of Law, The Outline of the Modern Chinese History, Introduction to Mao Zedong Thoughts and Theoretical System of Socialism with Chinese characteristics, College Student Occupation Career and Development Planning, Surveying Management and Laws, Situation and Policy (1-4), Navigation and Positioning Comprehensive Practice, etc.
	8.3 Understand the social responsibility of Navigation workers for public safety, health, well-being and environmental protection, and be able to consciously perform their responsibilities in Navigation engineering practice	The Generality of Basic Principle of Marxism, Introduction to Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, College Student Occupation Career and Development Planning, Situation and Policy (5-8), Introduction to Earth Science, Surveying Management and Laws, GNSS Deformation Monitoring Technology and Application, Graduation

Graduate Abilities	Related Knowledge	Course Supports
		design and defense, etc. .
9. Individuals and teams: Be able to play the role of individual, team member and leader in the team under the background of architecture, civil engineering and other disciplines.	9.1 Be able to communicate effectively with members of architecture, civil engineering and other disciplines	College Student Occupation Career and Development Planning, Physical Education (1-4), Introduction to Civil Engineering, Introduction to Navigation Engineering, Graduation design and defense, etc..
	9.2 Ability to work independently or cooperatively in a team	Digital Topographic Surveying Practice, Foundation of Geodesy Practice, Satellite Navigation and Positioning Practice, Foundation of Navigation Equipment Practice, Navigation and Positioning Comprehensive Practice, High-precise Map Technology and Application Practice, Driverless High Precision Mapping and Application Practice, Navigation and Positioning Comprehensive Practice, etc. .
	9.3 Ability to organize, coordinate and direct the work of the team	The Outline of the Modern Chinese History, Navigation and Positioning Comprehensive Practice, Foundation of Navigation Equipment Practice, Inertial Navigation Principle Practice, Embedded System and Programming Design Practice, Graduation design and defense, etc. .
10. Communication: Be able to effectively communicate and communicate with navigation engineering peers and the public on complex navigation engineering problems, including writing navigation technology	10.1 Be able to accurately express opinions, respond to queries, and understand the differences of communication with navigation engineering peers and the public in written statements and statements on Navigation technology design book and survey technology summary	Introduction to Navigation Engineering, Principle of Combined Navigation, Urban High Precise GNSS Positioning Data Processing, Driverless High Precision Mapping and Application, High-precise Map Technology and Application, The Mental health of College Students, Graduation design and defense, etc.

Graduate Abilities	Related Knowledge	Course Supports
design book and navigation technology summary, making statements, clearly expressing or responding to instructions, and having a certain international vision, and being able to communicate and exchange in cross-cultural background.	10.2 Understand the international development trends and research hotspots in the field of Navigation, and understand and respect the differences and diversity of different cultures	Introduction to Geometrics, Introduction to Navigation Engineering, Principle of Satellite Navigation, Principle of Inertial Navigation, Indoor Navigation and Positioning Technology, Compound Culture Class, etc..
	10.3 Have the ability of cross-cultural communication language and written expression, and be able to carry out basic communication and exchange on Navigation professional issues under the cross-cultural background	Scientific Paper Writing, College English Training, Engineering Practice, Compound Culture Class, etc..
11. Project management: Understand and master the principles of engineering management and economic decision-making methods, and can be applied in surveying and mapping, architecture, civil engineering, environment and other disciplines.	11.1 master the management and economic decision-making methods involved in engineering projects	Introduction to Earth Science, Introduction to Civil Engineering, Marketing Management, Graduation Design and Defense, etc.
	11.2 understand the cost composition of the whole process of navigation engineering and product development, and understand the engineering management and economic decision issues involved	Foundation of Navigation Equipment, Marketing Management, Surveying Management and Laws, Geographic Conditions Monitoring, Graduation design and defense, etc.
	11.3 be able to use engineering management and economic decision making methods in the design and development of navigation solutions in a multidisciplinary environment such as civil engineering and architecture	Principle of Inertial Navigation, Principle of Combined Navigation, Urban High Precise GNSS Positioning Data Processing, Driverless High Precision Mapping and Application Practice, High-precise Map Technology and Application, Graduation design and defense, etc. .

Graduate Abilities	Related Knowledge	Course Supports
12. Lifelong learning: Have the consciousness of self-learning and lifelong learning, and have the ability of continuous learning and adapting to development.	12.1 Under the background of social development, we can realize the necessity of self-learning and lifelong learning	Ideological Morality and Rule of Law, College Student Occupation Career and Development Planning, College English Training, Surveying Management and Laws, etc..
	12.2 Have the ability of self-learning and adapting to development, including the ability to understand the Navigation technical problems, the ability to summarize and the ability to ask questions.	The Generality of Basic Principle of Marxism, Introduction to Mao Zedong Thoughts and Theoretical System of socialism with Chinese characteristics, Introduction to Earth Science, Scientific Paper Writing, Introduction to smart city, Graduation design and defense, Innovation Training Project of Scientific Research Team, etc. .

X Table of Teaching Arrangement (appendix table 1~2)

表 1 导航工程（智能导航实验班）专业指导性教学计划（1）

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续学时	开课学期	教学单位
通识教育课	必修	思想道德与法治 Ideological Morality and Rule of Law	3	48	48					1	马克思主义学院
		中国近现代史纲要 The Outline of the Modern Chinese History	3	48	32			16		2	马克思主义学院
		习近平新时代中国特色社会主义思想概论 Introduction to Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era	3	48	48					2	马克思主义学院
		习近平新时代中国特色社会主义思想在京华大地的生动实践 The Vivid Practice of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era in Beijing	0.5	8	8					2	马克思主义学院
		马克思主义基本原理★ Basic Principle of Marxism	3	48	48					3	马克思主义学院
		毛泽东思想和中国特色社会主义理论体系概论★ Introduction to Mao Zedong Thoughts and Theoretical System of Socialism with Chinese Characteristics	3	48	48					4	马克思主义学院
		形势与政策（1-4） Situation and Policy(1-4)	2	32	32					1-4	马克思主义学院
		大学生职业生涯与发展规划 College Student Occupation Career and Development Planning	1	16	16					1	学工部
		大学生心理健康 The Mental Health of College Students	1	16	16					2	学工部
		大学英语(1-2) ★ College English(1-2)	6	128	96				32	1-2	人文学院
		大学英语拓展系列课程（1-4） College English Training（1-4）	2	32	32					3	人文学院
		大学英语拓展系列课程（5-8） College English Training（5-8）	2	32	32					4	人文学院
		体育(1-4) Physical Education(1-4)	4	120	120					1-4	体育部
		计算思维导论 Introduction to Computational Thinking	1.5	56	24			32		1	电信学院
		“四史”（党史、新中国史、改革开放史、社会主义发展史） History of the Communist Party of China, History of New China, History of Reform and Opening up and History of Socialist Development	0.5	8	8					1-7	马克思主义学院
		小 计	35.5	688	608			48	32		
	核心	特色课程与人文素养	2	32						1-8	各院部
		经典研读与文化传承	2	32						1-8	各院部
		科技文明与城市发展	2	32						1-8	各院部
		建筑艺术与审美教育	2	32						1-8	各院部
		修读 4 类合计 8 学分，每类至少修读 2 学分									
	任选	工程实践类	1-8 学期任选								各院部
		复合培养类	1-8 学期任选								各院部
		任选至少修读 2 学分									
	通识教育课合计至少修读 45.5 学分。 其中通识教育必修 35.5 学分（含“四史”（党史、新中国史、改革开放史、社会主义发展史），四选一，1-7 学期内任意学期完成，0.5 学分），通识教育核心 8 学分，通识教育任选 2 学分（含体育类课程 1 学分）。										

表 1 导航工程（智能导航实验班）专业指导性教学计划（2）

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
学科基础课	必修	高等数学 A（1）★ Advanced Mathematics A(1)	5	92	80				12	1	理学院
		高等数学 A（2）★ Advanced Mathematics A(2)	5	84	80				4	2	理学院
		线性代数 Linear Algebra	2	40	32				8	2	理学院
		概率与数理统计 B Theory of Probability and Statistics (B)	3	48	44				4	3	理学院
		普通物理 A（1）★ College physics A(1)	3	52	48			4		2	理学院
		普通物理 A（2）★ College physics A(2)	3	52	48			4		3	理学院
		物理实验（1-2） Physics Experiment(1-2)	2	60		60				3-4	理学院
		测绘地理信息概论 Introduction to Geomatics	1	16	16					1	测绘工程系
		导航工程概论 Introduction to Navigation Engineering	1	16	16					1	导航工程系
		地球科学概论 Introduction to Earth Science	2	32	32					1	地理信息科学系
		C/C++程序设计★ C/C++ Programming Design	3	48	40	8		48		1	遥感科学与技术系
		数字地形测量学 Digital Topographic Surveying	2	32	28	4				2	测绘工程系
		摄影测量与遥感原理 Principles of Photogrammetry and Remote Sensing	2	32	28	4				2	遥感科学与技术系
		导航装备基础 Foundation of Navigation Equipment	2	32	32					2	导航工程系
		数字信号处理★ Digital Signal Processing	2	32	28	4				3	导航工程系
		嵌入式系统与程序设计★ Embedded Systems and Programming Design	3.5	56	50		6			3	导航工程系
		导航学★ Navigation	2	32	32					3	导航工程系
		误差理论与测量平差基础 Error Theory and Foundation of Surveying Adjustment	2	32	32					4	测绘工程系
		大地测量学基础 Foundation of Geodesy	2	32	30	2				4	导航工程系
		最优估计★ Optimal Estimation	2	32	32					5	导航工程系
		地理信息系统原理 Principle of Geographic Information System	2	32	24		8			5	地理信息科学系
		小 计	51.5	884	752	82	14	56	28		
	学科基础课合计必修 51.5 学分										
专业	必修	卫星导航原理★ Principle of Satellite Navigation	3	48	40	8				4	导航工程系
		惯性导航原理★ Principle of Inertial Navigation	2	32	28	4				4	导航工程系

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
核心课		信号与系统★ Signals and Systems	2	32	28	4				5	测绘工程系
		组合导航★ Principle of Combined Navigation	2	32	28	4				5	导航工程系
		卫星导航算法与程序设计★ Programming for Satellite Navigation and Positioning	3	48	40		8			5	导航工程系
		导航电子地图★ Navigation Electronic Map	2	32	28	4				6	导航工程系
		自动控制原理★ Principle of Automatic Control	2	32	28	4				6	导航工程系
		小计	16	256	220	28	8				
	专业核心课合计必修16学分										
专业方向课	必修	室内导航与定位技术 Indoor Navigation and Positioning Technology	2	32	28	4				5	地理信息科学系
		无人驾驶高精地图及应用 Driverless High-precise Map and Application	2	32	32					6	测绘工程系
		机器人导航原理与技术 Robot Navigation Principles and Technology	2	32	30	2				6	导航工程系
		城市时空大数据技术 Urban Spatiotemporal Big Data Technology	2	32	28	4				7	导航工程系
		小　计	8	128	118	10					
	选修	土木工程概论 Introduction to Civil Engineering	3	48	48					5	土木学院
		工程制图与识图 Engineering Drawing and Interpreting	2	32	32					6	理学院
		计算机图形学 Computer Graphics	2	32	24	8				6	地理信息科学系
		测绘管理与法律法规 Surveying Management and Laws	1	16	16					6	测绘工程系
		科技论文写作（双语） Scientific Paper Writing	1	16	16					6	测绘工程系
		科技文献检索 Document Retrieval of Science and Technology	1	16	16					5	图书馆
		城市规划概论 Conspectus of Urban Planning	1.5	24	20	4				7	建筑学院
		市场营销 Marketing Management	1.5	24	24					7	经管学院
		GNSS增强技术及应用 GNSS Enhancement Technology and Application	1	16	14	2				5	测绘工程系
		城市高精度GNSS定位数据处理 Urban High Precise GNSS Positioning Data Processing	1.5	24	20	4				6	导航工程系

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
		GNSS 变形监测技术及应用 GNSS Deformation Monitoring Technology and Application	1.5	24	20	4				7	导航工程系
		GNSS 时频测量及应用 GNSS Time-frequency Measurement and Application	1	16	14	2				7	导航工程系
		导航芯片制造概论 Introduction to Navigation Chip Manufacturing	1	16	16					5	导航工程系
		Verilog VHDL 语言 Verilog VHDL Language	1.5	24	20	4				6	导航工程系
		PCB 设计与制作 PCB Design and Manufacture	1.5	24	20	4				7	导航工程系
		UNIX/LINUX 操作系统 UNIX/LINUX Operation System	1	16	10		6			5	测绘工程系
		视觉导航技术 Visual Navigation Technology	1.5	24	20	4				6	导航工程系
		导航产品设计与实现 Design and Implementation of Navigation Products	1	16	12	4				7	导航工程系
		城市空间信息学 Urban Spatial Information Science	2	32	24	8				5	地理信息科学系
		遥感数字图像处理 Remote Sensing Digital Image Processing	2	32	24	8				5	遥感科学与技术系
		工业智能定位测量 Industrial Intelligent Positioning Survey	1	16	12	4				6	测绘工程系
		智慧城市导论 Introduction to smart city	1	16	16					6	地理信息科学系
		激光雷达测量技术与应用 The Application and Technology of Laser Radar Surveying	2	32	24	8				7	测绘工程系
		自然资源管理 Geographic Conditions Monitoring	1.5	24	16	8				7	地理信息科学系
		软件工程与 Web 技术 Software Engineering and Web Technology	1	16	12	4				5	导航工程系
		时空人工智能技术 Spatiotemporal Artificial Intelligence Technology	1.5	24	20	4				6	地理信息科学系
		手机室内导航与位置服务 Mobile Indoor Navigation and Location Service	1.5	24	20	4				6	地理信息科学系
		小　计	39	624	530	88	6				
	专业方向课合计 20 学分，必修 8 学分，任选至少修读 12 学分										

表 2 导航工程（智能导航实验班）专业指导性教学计划（实践环节）

课程属性	课程名称	学分	折合学时	实验实践	上机	开课学期	开设周次	教学单位
课内	军事理论 Military Theory	2	36			1	1-3	武装部
	军训 Military Training	2	112					
	劳动教育（1-2） Labor Education(1-2)	1	32			3、7	分散	学工部、各院部
	形势与政策（5-8） Situation and Policy (5-8)	0	32			5-8	分散	马院、各学院
	C/C++程序设计实习 C/C++ Programming Design Practice	1	20		20	1	20	遥感科学与技术系
	数字地形测量实习 Digital Topographic Surveying Practice	2	40	40		2	17-18	测绘工程系
	摄影测量与遥感原理实习 Principles of Photogrammetry and Remote Sensing Practice	1	20		20	2	19	遥感科学与技术系
	导航装备基础实习 Foundation of Navigation Equipment Practice	1	20	10	10	2	20	导航工程系
	数字信号处理实习 Digital Signal Processing Practice	1	20		20	3	18	导航工程系
	嵌入式系统与程序设计实习 Embedded System and Programming Design Practice	2	40		40	3	19-20	导航工程系
	大地测量学基础实习 Foundation of Geodesy Practice	1	20	20		4	17	导航工程系
	卫星导航原理实习 Satellite Navigation and Positioning Practice	1	20	20		4	18	导航工程系
	测量平差基础实习 Foundation of Surveying Adjustment Practice	1	20		20	4	19	测绘工程系
	惯性导航原理实习 Inertial Navigation Principle Practice	1	20	20		4	20	导航工程系
	信号与系统实习 Signals and Systems Practice	1	20		20	5	17	测绘工程系
	地理信息系统原理实习 Principle of Geographic Information System Practice	1	20		20	5	18	地理信息科学系
	组合导航实习 Integrated Navigation Practice	1	20	20		5	19	导航工程系
	室内导航与定位技术实习 Indoor Navigation and Positioning Technology Practice	1	20	20		5	20	导航工程系
	无人驾驶高精地图及应用实习 Driverless High-precise Map and Application Practice	1	20	20		6	17	测绘工程系
	导航电子地图实习 Navigation Electronic Map Practice	1	20		20	6	18	导航工程系
	自动控制原理实习 Automatic Control Principle Practice	1	20	20		6	19	导航工程系
	机器人导航原理与技术实习 Robot Navigation Principle and Technology Practice	1	20	20		6	20	导航工程系

课程属性	课程名称		学分	折合学时	实验实践	上机	开课学期	开设周次	教学单位
	导航定位综合实习 Navigation and Positioning Comprehensive Practice		3	60	60		7	1-3	导航工程系
	城市时空大数据技术实习 Urban Spatiotemporal Big Data Technology Practice		1	20	20		7	20	导航工程系
	毕业设计与毕业答辩 Graduation design and defense		8	160	160		8	1-16	导航工程系
	小 计		37	852	450	190			
课外	创新实践及科研训练	科研团队创新训练-导航基础研发能力实训 Innovation Training Project of Scientific Research Team	1	20	20		2		导航工程系
		科研团队创新训练-导航产品/系统研制能力实训 Innovation Training Project of Scientific Research Team	1	20	20		3		导航工程系
		科研团队创新训练-团队协作与创新创业能力实训（1） Innovation Training Project of Scientific Research Team (1)	1	20	20		4		导航工程系
		科研团队创新训练-团队协作与创新创业能力实训（2）Innovation Training Project of Scientific Research Team (2)	1	20	20		5		导航工程系
		测绘程序设计大赛实训 Surveying Programming Contest Practice	2	40	40		6		导航工程系
		测绘技能大赛实训 Surveying Skills Contest Practice	2	40	40		6		测绘工程系
		北斗创新创业大赛 Beidou Innovation and Entrepreneurship Contest	1	20	20		2-7		导航工程系
		“北斗杯”全国青少年科技创新大赛 Beidou Cup National Youth Science and Technology Innovation Contest	1	20	20		2-7		导航工程系
		各类学科竞赛获奖(创新学分) Awards in Various Discipline Competitions (Innovation Credits)	1				1-8		测绘学院
	小 计		11	200	200				
实践环节合计 43 学分，课内必修 37 学分，课外（创新实践及科研训练）必修 6 学分									

2022 级地理空间信息工程专业本科培养方案

一、专业基本信息

英文名称	Geospatial Information Engineering		
专业代码	081205T	学科门类	工学
学　　制	四年	授予学位	工学学士

二、培养目标及特色

培养目标：

本专业培养德、智、体全面发展的地理空间信息复合型工程技术人才，具备数理基础和人文社科知识，掌握自然地理学和地理信息系统的基础知识、基本理论、分析方法和应用技能，接受科学思维和工程实践训练，具备利用测绘、遥感、卫星定位导航等技术获取地理数据的能力，掌握一定的数理统计分析和计算机技术，具有定量分析、研究地理问题的能力。能够胜任城市规划、地理国情、资源管理、环境保护等领域地理信息系统的设计、生产、研发及管理工作，具有较强的组织管理能力、创新能力、继续学习能力和国际视野。毕业后经过 5 年左右的工作和学习，能够达到如下目标：

（1）掌握数学、自然科学、工程基础及先进的地理信息系统理论与技术，胜任地理空间信息工程设计、开发及管理等专业技术工作；

（2）具有良好专业素养、丰富的工程管理经验和极强工作责任心，成为地理信息企事业单位中的技术负责人或技术骨干；

（3）具有继续学习适应发展的能力，能够独立或协同承担地理空间信息科研工作；

（4）具有良好的团队意识、国际化视野和沟通能力，能够承担团队中的领导角色；

（5）具有良好的思想道德修养和科学文化素养，能够承担和履行社会责任。

专业特色：

本专业依托首都建设和学校土木建筑类学科优势，培养服务首都、面向全国的城市信息化建设的专业地理信息人才。适应地理信息高新科技发展，融教学、科研和生产为一体，强调理论与实践密切结合，突出城市空间信息特色，培养地理信息系统新技术、新方法的应用及软件设计开发的综合能力，满足城市空间信息化建设的地理信息系统人才需求。

三、主干学科

测绘科学技术、地理学、计算机应用。

四、主干课程

1．主干基础课程（9 门）

测绘地理信息概论、工程制图与识图、C 语言程序设计、地球科学概论、数字地形测量学、地图学、CAD 基础与应用、地理信息系统原理（双语）、遥感原理与应用

2．主干专业课程（6 门）

空间数据库、空间分析与建模、地理信息系统设计与开发、WebGIS 技术与开发、城市空间信息学、误差理论与测量平差基础

五、主要实践教学环节（12 门）

数字地形测量学实习、地图学实习、C#程序实习、空间数据库实习、地理信息系统原理实习、遥感原理与应用实习、地理信息系统设计与开发实习、摄影测量基础实习、空间分析与建模实习、自然地理地貌及遥感图像解译实习、空间信息综合实习、毕业设计或论文

六、毕业学分要求

参照北京建筑大学本科学生学业修读管理规定及学士学位授予细则，修满本专业最低计划学分应达到 168.5 学分，其中，理论课程 131.5 学分，实践教学环节 37 学分。

七、各类课程结构比例

课程类别	课程属性	学分	学时	学分比例
通识教育课	必修	43.5	736	25.82%
	选修	2	32	1.19%
大类基础课	必修	43	756	25.52%
	选修	1	16	0.59%
专业核心课	必修	16	256	9.50%
专业方向课	必修	6	96	3.56%
	选修	20	320	11.87%
独立实践环节	必修	35	812	20.77%
	选修	2	40	1.19%
总计		168.5	3064	100%

八、教学进程表

学期	教学周	考试	实践	学期	教学周	考试	实践
1	4-19 周	20 周	1-3	2	1-16 周	17 周	18-20 周
3	1-15 周	16 周	17-20 周	4	1-15 周	16 周	17-20 周
5	1-15 周	16 周	17-20 周	6	1-14、16-19 周	20 周	15 周
7	7-20 周		1-6 周	8	1-16 毕业设计/实习 17 周答辩		

九、毕业生应具备的知识能力及实现矩阵

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
1.工程知识：能够将数学、自然科学、工程基础和专业知识用于解决复杂地理空间信息工程问题。	1.1 能够将数学、自然科学、工程科学的语言工具用于地理空间信息工程问题的表述	计算思维导论、C 语言与数据结构、CAD 基础与应用、工程制图与识图、高等数学 A(1-2)、概率论与数理统计 B、普通物理 A(1-2)、物理实验（1-2）、线性代数、土木工程概论、地图学、地球科学概论、计算机图形学等、数字图像处理。
	1.2 能针对具体的地理空间对象建立数学模型并求解	高等数学 A(1-2)、线性代数、数字地形测量学、地理信息系统原理（双语）、摄影测量基础、误差理论与测量平差基础、空间分析与建模、城市地理学 CIM 技术与应用、大数据与地理信息系统、人工智能在地理信息系统中的应用。
	1.3 能够将相关知识和数学模型方法用于推演、分析地理信息系统专业复杂工程问题	计算思维导论、CAD 基础与应用、工程制 2 图与识图、线性代数、卫星导航定位技术、激光雷达测量技术与应用、计算机图形学、城市空间信息学、CIM 技术与应用等。
	1.4 能够将相关知识和数学模型方法用于地理信息工程专业复杂工程问题解决方案的比较与综合	C 语言程序设计、数据结构、c#程序设计、Java 程序设计、Python 程序设计、概率论与数理统计 B、三维地理信息技术、近景摄影测量、数字地形测量实习、地图学实习、摄影测量基础实习、空间信息综合实习、毕业设计等。
2.问题分析：能够应用数学、自然科学和工程科学的基本原理，识别、表达、并通过文献研究分析复杂地理信息工程问题，以获得有效结论。	2.1 能够将数学、自然科学与工程科学的基本理论运用到识别、分析与表达	计算思维导论、C 语言程序设计、高等数学 A(1-2)、概率论与数理统计 B、物理实验（1-2）、线性代数、C#程序设计、地图学、地理信息系统原理（双语）、地球科学概论、空间分析与建模、摄影测量基础实习、空间分析与建模等。
	2.2 能够基于相关科学原理和数学模型方法正确表达复杂地理空间信息工程问题	CAD 基础与应用、数字地形测量学、误差理论与测量平差基础、激光雷达测量技术与应用、三维地理信息技术、GIS 基础应用技能等。
	2.3 能够认识到解决问题有多种方案可选择，会通过文献研究寻求	C 语言程序设计、数据结构、科技文献检索、摄影测量基础、地理信息系统原理实习、空间信息综合实习等。

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
	可替代的解决方案	
	2.4 能运用基本原理，借助文献研究，分析过程的影响因素，获得有效结论	普通物理 A(1-2)、科技文献检索、卫星导航定位技术、毕业设计等。
3.设计/开发解决方案：能够设计针对复杂地理空间信息工程问题的解决方案，设计满足特定需求的系统、生产流程，并能够在设计环节中体现创新意识，考虑社会、健康、安全、法律、文化以及环境等因素。	3.1 掌握地理信息系统设计/开发全周期、全流程的基本设计/开发方法和技术，了解影响设计目标和技术方案的各种因素	计算思维导论、CAD 基础与应用、GIS 基础应用技能、智慧城市导论、空间分析与建模、地理信息系统设计与开发、空间数据库、WebGIS 概论、摄影测量基础实习、空间信息综合实习等。
	3.2 能够设计开发满足特定地理空间信息工程需求的生产流程及系统	C 语言程序设计、数据结构、CAD 基础与应用、遥感原理、地理信息系统原理(双语)、地理信息系统设计与开发、空间数据库、WebGIS 概论、摄影测量基础、卫星导航定位技术、激光雷达测量技术与应用、地图设计与编绘、地图学实习、地理信息系统原理实习等。
	3.3 能够在地理空间信息工程解决方案设计中体现创新意识，考虑社会、健康、安全、法律、文化以及环境等因素	测绘地理信息概论、WebGIS 概论、地理信息系统设计与开发、数字地形测量学、大数据与地理信息系统、人工智能在地理信息系统中的应用、创新实践（GIS 大赛）、数字地形测量实习、创新创业类、毕业设计等。
4.研究：能够基于科学原理并采用科学方法对复杂地理空间信息工程问题、地理问题进行研究，包括设计实验、分析与解释数据、并通过信息综合得到合理有效的结论。	4.1 能够运用科学原理对复杂地理空间信息工程问题、地理问题提出研究方案	地球科学概论、地图学、地理信息系统原理（双语）、智慧城市导论、遥感原理实习、地图学实习等。
	4.2 能够基于专业理论知识对研究方案进行设计、论证与预测	计算思维导论、大数据与地理信息系统、人工智能在地理信息系统中的应用、工程制图与识图、遥感原理、摄影测量基础、卫星导航定位技术、空间信息综合实习等。
	4.3 能够采用科学方法实施数据采集与分析处理	C#程序设计、C 语言程序设计、数据结构、空间数据库、误差理论与测量平差基础、激光雷达测量技术与应用、遥感数字图像处理、摄影测量基础实习等。

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
	4.4 能够对实验结果进行信息综合与评判，取得合理有效结论	科技文献检索、地图学、科技论文写作（双语）、空间分析与建模、空间信息综合实习、毕业设计等。
5.使用现代工具：能够针对复杂地理空间信息工程问题，开发、选择与使用恰当的地理信息系统技术、资源、数据采集设备和信息技术，包括对复杂理空间信息工程问题的预测与模拟，并能够理解其局限性。	5.1 能够针对复杂地理空间信息工程问题，选择恰当的数据获取方法与技术	大学英语（1-2）、计算思维导论、卫星导航与定位、C 语言与数据结构、CAD 基础与应用、C#程序设计、数字地形测量学、激光雷达测量技术与应用、三维地理信息技术、计算机图形学、GIS 基础应用技能、智慧城市导论、测绘地理信息技术前沿、数字地形测量实习、遥感原理实习、地图学实习、GIS 软件开发大赛实训等。
	5.2 能够使用现代数据采集设备和信息技术软件完成地理信息系统数据采集、数据处理与精度分析	空间分析与建模、空间数据库、工程制图与识图、高等数学 A（1-2）、概率论与数理统计 B、数字地形测量学、遥感原理、地图学、摄影测量基础、卫星导航定位技术、误差理论与测量平差基础、遥感数字图像处理、数字地形测量实习、遥感原理实习、地理信息系统原理实习、空间信息综合实习、毕业设计、测绘技能大赛实训、GIS 软件开发大赛实训等。
	5.3 能够使用现代工具，对复杂地理空间信息工程问题、地理问题进行预测与模拟，并理解其局限性	概率论与数理统计 B、普通物理（1-2）、线性代数、科技文献检索、误差理论与测量平差基础、大数据与地理信息系统、人工智能在地理信息系统中的应用、摄影测量基础实习、毕业设计、创新实践（GIS 技能大赛、测绘技能大赛、测绘科技论文大赛）等。
6.工程与社会：能够基于工程相关背景知识进行合理分析，评价地理空间信息工程实践和复杂地理空间信息工程问题解决方案对社会、健康、安全、法律以及文化的影响，并理解应承担的责任。	6.1 熟悉地理信息系统专业相关技术标准、法律法规及管理规定，能够基于工程相关背景知识进行合理分析	思想道德与法治、数字地形测量学、遥感原理、空间分析与建模、城市地理学、卫星导航定位技术、数字地形测量实习、地理信息系统原理实习、工程实践类、毕业设计等。
	6.2 能够评价地理空间信息工程实践和复杂地理空间信息工程问题、地理问题的解决方案对社会、健康、安全、	中国近现代史纲要、马克思主义基本原理、毛泽东思想和中国特色社会主义理论体系概论、军事理论、工程测量学、城市空间信息学、城市地理学、经典赏析与文化传承、哲学逻辑与文明对话、科技革命与社会发

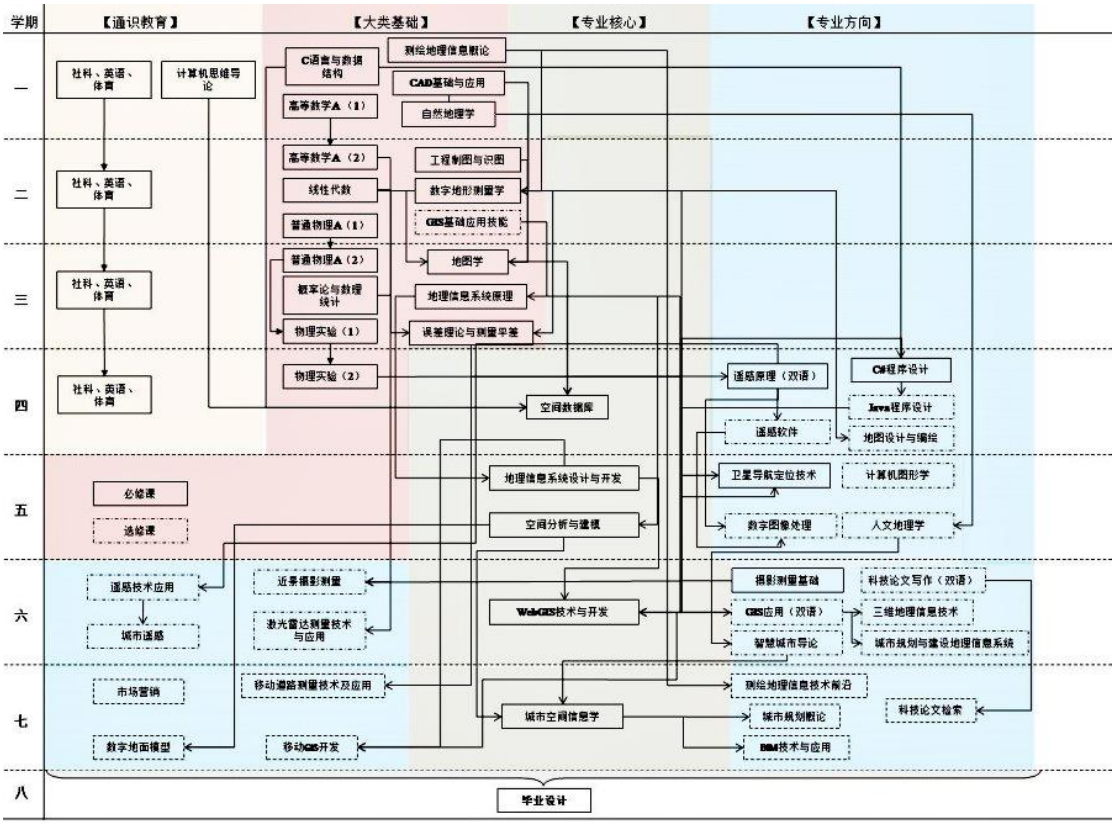
毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
	法律以及文化的影响，以及这些制约因素对项目实施的影响，并理解应承担的责任	展、建筑艺术与审美教育、生态文明与未来城市等。
7.环境和可持续发展：能够理解和评价针对复杂地理空间信息问题的地理空间信息工程实践对环境、社会可持续发展的影响。	7.1 知晓和理解环境保护和可持续发展的理念和内涵	物理实验（1-2）、测绘地理信息概论、地球科学概论、遥感数字图像处理、形势与政策（1-2）等。
	7.2 能够从环境保护和可持续发展的角度认知地理空间信息工程实践活动的可持续性，以及评价测绘工程生产实践中可能对环境及社会造成的损害和隐患	地球科学概论、智慧城市导论、城市地理学、城市空间信息学、大数据与地理信息系统、遥感原理、复合培养类、毕业设计等。
8.职业规范：具有人文社会科学素养、社会责任感，能够在地理空间信息工程实践中理解并遵守地理信息系统行业职业道德和规范，履行责任。	8.1 具有人文社会科学素养，树立正确的世界观、人生观和价值观	思想道德与法治、中国近现代史纲要、马克思主义基本原理、毛泽东思想和中国特色社会主义理论体系概论、军事理论、体育（1-4）、军训等。
	8.2 理解诚实公正、诚信守则的测绘行业职业道德和规范，并能在地理空间信息工程实践中自觉遵守	思想道德与法治、中国近现代史纲要、毛泽东思想和中国特色社会主义理论体系概论、大学生职业生涯与发展规划、测绘地理信息概论、地理信息系统设计与开发、WebGIS概论、形势与政策（1-2）、数字地形测量实习、空间信息综合实习等。
	8.3 理解地理空间信息工程工作人员对公众的安全、健康、福祉、环境保护的社会责任，能够在地理空间信息工程实践中自觉履行责任	马克思主义基本原理、大学生职业生涯与发展规划、测绘地理信息概论、地球科学概论、毕业设计等。
9.个人和团队：能够在多学科背景下的团队中承担个体、团队成员以及责任人的角色。	9.1 能与建筑、土木等学科的成员有效沟通，合作共事	大学生职业生涯与发展规划、体育（1-4）、工程力学、城市地理学、C#程序设计、毕业设计等。
	9.2 能够在团队中独立	军事理论、军训、创新实践（测绘技能大赛、

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
	或合作开展工作	测绘科技论文大赛）、数字地形测量实习、遥感原理实习、测绘技能大赛实训、GIS 软件开发大赛实训等。
	9.3 能够组织、协调和指挥团队开展工作	中国近现代史纲要、军事理论、地图学实习、地理信息系统原理实习、空间信息综合实习、激光雷达测量技术实习、毕业设计等。
10.沟通：能够就复杂地理空间信息工程问题与地理信息同行及社会公众进行有效沟通和交流，包括撰写报告和设计文稿、陈述发言、清晰表达或回应指令，并具备一定的国际视野，能够在跨文化背景下进行沟通和交流。	10.1 能够在撰写设计书、技术报告以及陈述发言中，就复杂地理空间信息工程问题与地理信息同行及社会公众进行有效沟通和交流	地图学实习、地理信息系统设计与开发、WebGIS 概论、空间信息综合实习、毕业设计等。
	10.2 具备一定的国际视野，了解测绘领域的国际前沿发展趋势和研究热点	大学英语（1-2）、遥感原理、地理信息系统原理（双语）、空间信息综合实习、大学英语拓展系列课程（1-8）、GIS 基础应用技能、遥感应用前景等。
	10.3 具有跨文化交流的语言和书面表达能力，能够就地理空间信息问题在跨文化背景下进行沟通和交流	大学英语（1-2）、科技论文写作（双语）、大学英语拓展系列课程（1-8）等。
11.项目管理：理解并掌握工程管理原理与经济决策方法，并能在多学科环境中应用。	11.1 掌握工程项目中涉及的管理与经济决策方法	地理信息系统设计与开发、地理信息系统原理（双语）、毕业设计等。
	11.2 了解地理信息系统生产的成本构成，理解其中涉及的工程管理与经济决策问题	地理信息系统设计与开发、地理信息系统原理（双语）毕业设计等。
	11.3 能在多学科环境下，在设计开发的过程中，运用工程管理与经济决策方法	空间信息综合实习、不动产测量与管理实习、地理信息系统设计与开发、城市地理学、毕业设计等。
12.终身学习：具有自主学习和终身学习的意识，有不断学习和适应发展的能力。	12.1 具有自主学习和终身学习的意识	思想道德与法治、大学生职业生涯与发展规划、大学英语（1-2）、测绘地理信息概论、误差理论与测量平差基础、测绘管理与法律

毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
		法规、测绘地理信息技术前沿、大学英语拓展系列课程（1-8）等。
	12.2 具有不断学习和适应发展的能力	马克思主义基本原理、毛泽东思想和中国特色社会主义理论体系概论、测绘地理信息概论、科技论文写作（双语）、智慧城市导论、测绘地理信息技术前沿、毕业设计、创新实践（测绘技能大赛、测绘科技论文大赛、GIS 技能大赛）等。

十、指导性教学计划（见附表）

十一、主要课程逻辑关系结构图



2022 Undergraduate Program for Specialty in Geospatial Information Engineering

I Specialty Name and Code

English Name	**Geospatial Information Engineering**		
Code	081205T	Disciplines	Bachelor of Engineering
Length of Schooling	4 years	Degree	Bachelor of Engineering

II Educational Objectives and Features

Objectives: This program is to cultivate geospatial information inter-disciplinary engineering talents, fully developed in morality, intelligence and physique, well equipped with mathematical science and social science, and highly skilled in basic knowledge, theory, analysis method and application skills of physical geography and geographical information system. The students are required to have the systematic training of scientific thinking and engineering practice, have the ability to use surveying and mapping, remote sensing, satellite positioning and navigation and other technologies to acquire geographic data, master mathematical statistical analysis and computer technology, and have the ability of quantitative analysis and geographical research, so that they are competent in design, production, R&D and management of geographical information system, including urban planning, geographical conditions, resource management and environmental protection. Besides, the graduates have a good ability of organizing, innovation, learning, and international vision as well. After about 5 years of work and study after graduation, the graduates can achieve the following goals:

(1) the knowledge of mathematics, natural science, engineering foundation and advanced theory and technology of geographic information system (GIS), competent in geospatial information engineering design, development and management, and other professional and technical work;

(2) Have good professional quality, rich engineering management experience and strong sense of responsibility, and become the technical leader or technical backbone of surveying and mapping geographic information enterprises and institutions;

(3) Have the ability to continue learning and adapt to development, and can independently or jointly undertake the research work of surveying and mapping geographic information;

(4) Good team awareness, international vision and communication skills, capable of taking the leading role in the team;

(5) Have good ideological and moral cultivation, scientific and cultural literacy, and can assume and fulfill social responsibilities.

Features: This program features integrating the teaching, research and production together with the development of high-technology, stressing the combination of theory and practice, highlighting the urban spatial information characteristics, and pinpointing the comprehensive ability of application of new GIS

technologies and software development. Based on the construction of Beijing and with the advantages of the civil construction disciplines of the University, this program aims to cultivate professional GIS talents for the urban informatization construction of Beijing and the whole country.

III Major Disciplines

Surveying Science and Technology, Geography, Computer Application

IV Major Courses

1. Basic Courses

Introduction to Geomatics, Engineering Drawing and Read Drawing, C Language Programming, Physical Geography, Digital Topographic Surveying, Cartography, CAD Basic and Application, The Principle of Geographic Information System (Bilingual), Principles of Remote Sensing

2. Specialty Courses

Spatial Database, Spatial Analysis and Modeling, Programming and Development for GIS, WebGIS Technology and Development, Urban Spatial Information Science, Fundamentals of Error Theory and Surveying Adjustment

V Major Practical Training

Digital Topographic Surveying Practice, Cartography Practice, C# Programming Practice, Spatial Analysis and Modeling Practice, The Principle of Geographic Information System Practice, Principles of Remote Sensing Practice, Programming and Development of GIS Practice, Photogrammetry Fundamental Practice, Spatial Analysis and Modeling Practice, Natural Geography and Remote Sensing Practice, Comprehensive Practice, Graduation Project or Thesis

VI Graduation Requirements

In accordance with "Management Regulations for the Undergraduate Students of Beijing University of Civil Engineering and Architecture" and "Bachelor's Degree Awarding Regulations", the minimum credits required by specialty for graduate is 168.5 including 131.5 credits of theoretical courses and 37 credits of practice teaching.

VII Proportion of Course

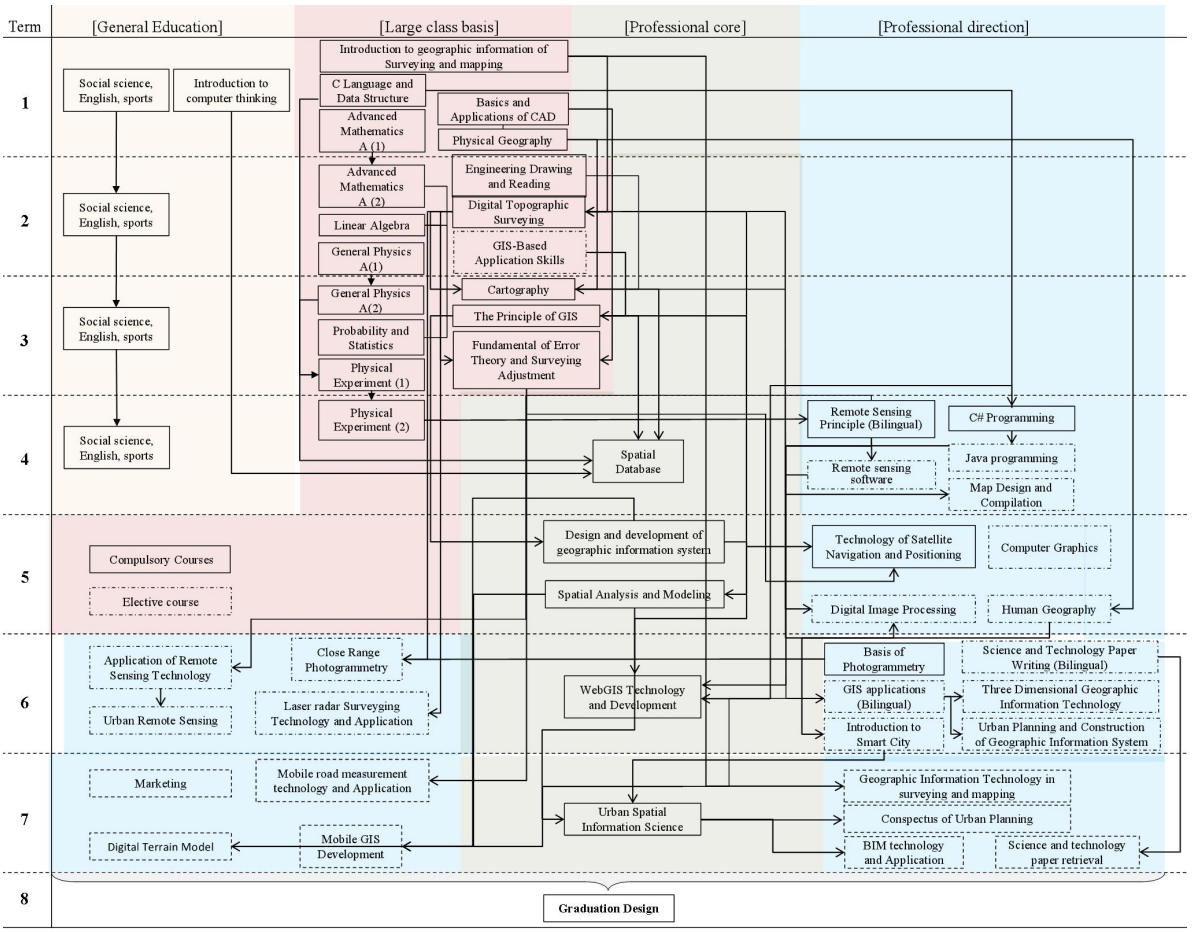
Course Category	Course Type	Credits	Class Hour	Proportion
General Education	Compulsory	43.5	736	25.82%
	Optional	2	32	1.19%
Big Academic Subjects	Compulsory	43	756	25.52%
	Optional	1	16	0.59%
Professional Core	Compulsory	16	256	9.50%

Course Category	Course Type	Credits	Class Hour	Proportion
Professional Direction	Compulsory	6	96	3.56%
	Optional	20	320	11.87%
Practice	Compulsory	35	812	20.77%
	Optional	2	40	1.19%
Total		168.5	3064	100%

VIII Table of Teaching Program

Semester	Teaching	Exam	Practice	Semester	Teaching	Exam	Practice
1	4-19	20	1-3	2	1-16	17	18-20
3	1-15	16	17-20	4	1-15	16	17-20
5	1-15	16	17-20	6	1-16	17	18-20
7	7-20		1-6	8	1-16 Undergraduate Design or Thesis 17 Graduation reply		

IX Table of Teaching Arrangement



X Graduate Abilities and Matrices

Graduate Abilities	Related Knowledge	Course Supports
1.Engineering knowledge: have the ability of solving complex engineering problems with mathematics, natural science, engineering foundation and professional knowledge.	1.1 Be able to use the language tools of mathematics, natural science and engineering science to express geospatial information engineering problems.	Introduction to Computational Thinking, C Language and Data Structure, CAD Basic and Application, Engineering Drawing and Read Drawing, Advanced Mathematics A (1-2), Theory of Probability and Statistics (B), College physics B(1), Physics Experiment(1-2), Linear Algebra, Introduction to Civil Engineering, Cartography, Introduction to Geoscience, Computer Graphics, Remote Sensing Image Processing.
	1.2 Be able to build and solve mathematical model for specific geospatial objects.	Advanced Mathematics A (1-2), Linear Algebra, Digital Topographic Surveying, The Principle of Geographic Information System (Bilingual Education), Photogrammetry Fundamental, Fundamentals of Error Theory and Surveying Adjustment, Spatial Analysis and Modeling，Urban geography，CIM Technology and Application, Big Data and Geographic Information System, Application of Artificial Intelligence in GIS.
	1.3 Be able to apply relevant knowledge and mathematical model method to deduce and analyze complex engineering problems of GIS Specialty	Introduction to Computational Thinking, CAD Basic and Application, Engineering Drawing and Read Drawing, Linear Algebra, Satellite Navigation and Positioning Technology, Laser Radar Surveying Technology and Application, Computer Graphics, Urban Spatial Information Science, CIM Technology and Application.
	1.4 Be able to use the relevant knowledge and mathematical model method to compare and synthesize the solutions of complex engineering problems in Geographic Information Engineering Specialty	C Language Programming, Data Structure, C# Programming, Java Programming, Python Programming, Theory of Probability and Statistics B, Technology of 3D GIS, Close Range Photogrammetry, Digital Topographic Surveying Practice, Cartography Practice, Photogrammetry Fundamental Practice,

Graduate Abilities	Related Knowledge	Course Supports
		Spatial Information Practice, Undergraduate Design, etc.
2. Problem analysis: Be able to apply the basic principles of mathematics, natural science and Engineering Science, identify, express, and analyze the complex geographic information engineering problems through literature research to obtain the effective conclusion.	2.1 Be able to apply the basic theories of mathematics, natural science and engineering science to identification, analysis and expression.	Introduction to Computational Thinking, C Language Programming, Advanced Mathematics A (1-2), Theory of Probability and Statistics (B), Physics Experiment (1-2), Linear Algebra, C# Programming, Cartography, The Principle of Geographic Information System (Bilingual Education), Introduction to Geoscience, Spatial Analysis and Modeling，Photogrammetry Fundamental Practice, Spatial Analysis and Modeling.
	2.2 Be able to correctly express complex geospatial information engineering problems based on relevant scientific principles and mathematical model method.	CAD Basic and Application, Digital Topographic Surveying, Fundamentals of Error Theory and Surveying Adjustment, Laser Radar Surveying Technology and Application, Technology of 3D GIS, GIS-based Application Skills, etc.
	2.3 Be able to recognize that there are multiple solutions to the problem, and seek alternative solutions through literature research	C Language Programming, Data Structure, Document Retrieval of Science and Technology, Photogrammetry Fundamental, The Principle of Geographic Information System Practice, Spatial Information Practice, etc.
	2.4 Be able to use the basic principles, with the help of literature research, analyze the influencing factors of the process, and obtain effective conclusions	College physics A (1-2), Document Retrieval of Science and Technology, Satellite Navigation and Positioning Technology, Undergraduate Design, etc.
3. Design/Develop solutions: Be able to solve complex geospatial information engineering problems with design solutions. The design meets	3.1 Master the basic design / development methods and technologies of the whole cycle and process of GIS design / development, and understand the various factors affecting the	Introduction to Computational Thinking, CAD Basic and Application, GIS-based Application Skills, Introduction to Smart City, Spatial Analysis and Modeling, Programming and Development of GIS, Spatial Database, WebGIS Technology and Development,

Graduate Abilities	Related Knowledge	Course Supports
the specific needs of system, the unit (components) or process, and can embody the sense of innovation in the design process, considering the society, health, and safety, law, culture and environment factors.	design objectives and technical solutions.	Photogrammetry Fundamental Practice, Spatial Information Practice, etc.
	3.2 Be able to design and develop production processes and systems to meet the needs of specific Geospatial Information Engineering	C Language Programming, Data Structure, CAD Basic and Application, Principles of Remote Sensing, The Principle of Geographic Information System (Bilingual Education), Programming and Development of GIS, Spatial Database, WebGIS Technology and Development, Photogrammetry Fundamental, Satellite Navigation and Positioning Technology, Laser Radar Surveying Technology and Application, Map Design and Compilation, Cartography Practice, The Principle of Geographic Information System Practice, etc.
	3.3 Be able to reflect innovation awareness in geospatial information engineering solution design, and consider social, health, safety, legal, cultural and environmental factors	Introduction to Geomatics, WebGIS Technology and Development, Programming and Development of GIS, Digital Topographic Surveying, Big Data and Geographic Information System, Application of Artificial Intelligence in GIS, Innovative practice (GIS Competition), Digital Topographic Surveying Practice, Innovation and Entrepreneurship, Undergraduate Design, etc.
4. Study: Be able to study complex engineering problems, including the design of experiments, analysis and interpretation of data, and get a reasonable and effective conclusion through the comprehensive information by using scientific methods based on scientific theory.	4.1 Be able to use scientific principles to put forward research plans for complex geospatial information engineering problems and geographic problems	Introduction to Geoscience, Cartography, The Principle of Geographic Information System (Bilingual Education), Introduction to Smart City, Principles of Remote Sensing Practice, Cartography Practice, etc.
	4.2 Be able to design, demonstrate and predict research plans based on professional theoretical knowledge	Introduction to Computational Thinking, Big Data and Geographic Information System, Application of Artificial Intelligence in GIS, Engineering Drawing and Read Drawing, Principles of Remote Sensing, Photogrammetry Fundamental, Satellite

Graduate Abilities	Related Knowledge	Course Supports
		Navigation and Positioning Technology, Spatial Information Practice, etc.
	4.3 Be able to use scientific methods to collect and analyze data.	C# Programming, C Language Programming, Data Structure, Spatial Database, Fundamentals of Error Theory and Surveying Adjustment, Laser Radar Surveying Technology and Application, Remote Sensing Image Processing, Photogrammetry Fundamental Practice, etc.
	4.4 Be able to synthesize and evaluate the experimental results and get reasonable and effective conclusions.	Document Retrieval of Science and Technology, Cartography, Academic Writing (Bilingual Education), Spatial Analysis and Modeling, Spatial Information Practice, Undergraduate Design or Thesis, etc.
5. Using modern tools: be able to develop, select and use appropriate GIS technology, resources, data collection equipment and information technology for complex geospatial information engineering problems, including prediction and Simulation of complex spatial information engineering problems, and understand their limitations.	5.1 Be able to select appropriate data acquisition methods and technologies for complex geospatial information engineering problem.	College English (1-2), Introduction to Computational Thinking, Satellite Navigation and Positioning Technology, C Language and Data Structure, CAD Basic and Application, C# Programming, Digital Topographic Surveying, Laser Radar Surveying Technology and Application, Technology of 3D GIS, Computer Graphics, GIS-based Application Skills, Introduction to Smart City, Advanced Technology of Surveying, Mapping and GIS, Digital Topographic Surveying Practice, Principles of Remote Sensing Practice, Cartography Practice, GIS Software Development Competition Practical Training.
	5.2 Be able to use modern data acquisition equipment and information technology software to complete GIS data acquisition, data processing and accuracy analysis.	Spatial Analysis and Modeling, Spatial Database, Engineering Drawing and Read Drawing, Advanced Mathematics A (1-2), Theory of Probability and Statistics (B), Digital Topographic Surveying, Principles of Remote Sensing, Cartography, Photogrammetry Fundamental, Satellite Navigation and Positioning Technology,

Graduate Abilities	Related Knowledge	Course Supports
		Fundamentals of Error Theory and Surveying Adjustment, Digital Topographic Surveying Practice, Principles of Remote Sensing Practice, The Principle of Geographic Information System Practice, Spatial Information Practice, Undergraduate Design or Thesis, Surveying and Mapping Skills Practice Contest, GIS Software Development Competition Practical Training, etc.
	5.3 Be able to use modern tools to predict and simulate complex geospatial information engineering problems and geographic problems, and understand their limitations.	Theory of Probability and Statistics (B), College physics (1-2), Linear Algebra, Document Retrieval of Science and Technology, Fundamentals of Error Theory and Surveying Adjustment, Big Data and Geographic Information System, Application of Artificial Intelligence in GIS, Photogrammetry Fundamental Practice, Undergraduate Design or Thesis, Innovative Practice (National University GIS Application Skills Contest，Surveying and Mapping Skills Contest，Surveying and Mapping Science and Technology Paper Contest)，etc.
6. Engineering and society: be able to conduct reasonable analysis based on the relevant background knowledge of the project, evaluate the impact of geospatial information engineering practice and complex geospatial information engineering problem solutions on society, health, safety, law and culture, and understand the responsibilities to be	6.1 Be familiar with relevant technical standards, laws and regulations and management regulations of GIS, and be able to make reasonable analysis based on relevant engineering background knowledge.	Thought Morals Accomplishment and Basic Law, Digital Topographic Surveying, Principles of Remote Sensing, Spatial Analysis and Modeling, Urban geography, Satellite Navigation and Positioning Technology, Digital Topographic Surveying Practice, The Principle of Geographic Information System Practice, Engineering Practice, Undergraduate Design or Thesis, etc.
	6.2 Be able to evaluate the impact of geospatial information engineering practice and complex geospatial information	The Outline of the Modern Chinese History, The Generality of Basic Principle of Marxism, Introduction to Mao Zedong Thought and Theoretical System of Socialism with Chinese Characteristics, Introduction to Mao Zedong

Graduate Abilities	Related Knowledge	Course Supports
undertaken.	engineering problems, solutions to geographical problems on society, health, safety, law and culture, as well as the impact of these constraints on project implementation, and understand the responsibilities to be undertaken.	Thought and Theoretical System of Socialism with Chinese Characteristics, Military Theory, Engineering Surveying, Urban Spatial Information Science, Urban geography, Classical appreciation and cultural inheritance, Philosophical vision and civilization dialogue, Scientific and technological revolution and social development, Architectural art and aesthetic education, Ecological Civilization and future City, etc.
7. Environment and sustainable development：Be able to understand and evaluate the influence of geospatial engineering practice with complex engineering problems for sustainable development of environment and society.	7.1 To know and understand the concept and connotation of environmental protection and sustainable development.	Physics Experiment (1-2), Introduction to Geomatics, Introduction to Geoscience, Remote Sensing Image Processing, Situation and Policy(1-4), etc.
	7.2 Be able to recognize the sustainability of geospatial information engineering practice activities from the perspective of environmental protection and sustainable development, and evaluate the possible damage and hidden dangers to the environment and society in the production practice of Surveying and mapping engineering.	Introduction to Geoscience, Introduction to Smart City, Urban geography, Urban Spatial Information Science, Big Data and Geographic Information System, Principles of Remote Sensing, Compound Culture, Undergraduate Design or Thesis.
8. Occupational norms: Equip with the quality of humanistic social sciences, sense of social responsibility, understand and follow professional ethics and criteria in engineering, be conscientious in the performance of one's	8.1 Equip with the quality of humanistic social sciences, set up correct world outlook, outlook on life and values.	Thought Morals Accomplishment and Basic Law, The Outline of the Modern Chinese History, The Generality of Basic Principle of Marxism, Introduction to Mao Zedong Thought and Theoretical System of Socialism with Chinese Characteristics, Military Theory, Physical Education (1-4), Military Training, etc.
	8.2 Understand the professional ethics and norms	Thought Morals Accomplishment and Basic Law, The Outline of the Modern Chinese

Graduate Abilities	Related Knowledge	Course Supports
duties.	of geospatial information industry in terms of honesty, fairness and integrity, and consciously abide by them in geospatial information engineering practice	History, Introduction to Mao Zedong Thought and Theoretical System of Socialism with Chinese Characteristics, College Student Occupation Career and Development Planning, Introduction to Geomatics, Programming and Development of GIS, WebGIS Technology and Development, Situation and Policy (1-2), Digital Topographic Surveying Practice, Spatial Information Practice, etc.
	8.3 Understand the social responsibility of geospatial information engineering staff for the safety, health, well-being and environmental protection of the public, and be able to consciously perform their responsibilities in geospatial information engineering practice	The Generality of Basic Principle of Marxism, College Student Occupation Career and Development Planning, Introduction to Geomatics, Introduction to Geoscience, Undergraduate Design or Thesis, etc.
9. Individuals and teams: Be able to play an important role of individual, team member and person in charge in the team of multi-subject background.	9.1 Able to effectively communicate and work with members of architecture, civil engineering and other disciplines	College Student Occupation Career and Development Planning, Physical Education (1-4), Engineering Mechanics, Urban geography, C# Programming, Undergraduate Design or Thesis, etc.
	9.2 Be able to work independently or collaboratively in a team	Military Theory, Military Training, Innovative Practice (Surveying and Mapping Skills Contest，Surveying and Mapping Science and Technology Paper Contest)，Digital Topographic Surveying Practice, Principles of Remote Sensing Practice, Surveying and Mapping Skills Practice Contest, GIS Software Development Competition Practical Training, etc.
	9.3 Be able to organize, coordinate and direct team	The Outline of the Modern Chinese History, Military Theory, Cartography Practice, The

Graduate Abilities	Related Knowledge	Course Supports
	work.	Principle of Geographic Information System Practice, Spatial Information Practice, Laser Radar Surveying Technology and Application Practice, Undergraduate Design or Thesis, etc.
10. Communication: Be able to communicate effectively with industry peers in complex engineering, including writing reports and design papers, summary statement, express oneself and response instruction clearly. Have international perspective and the ability of communicating between or among interlocutors of different cultural background	10.1 Be able to effectively communicate and exchange with geographic information peers and the public on complex geospatial information engineering issues in writing design books, technical reports and presentations.	Cartography Practice, Programming and Development of GIS, WebGIS Technology and Development, Spatial Information Practice, Undergraduate Design or Thesis, etc.
	10.2 Have international vision and understand the international cutting-edge development trend and research hotspot in the field of Surveying and mapping.	College English (1-2), Principles of Remote Sensing, The Principle of Geographic Information System(Bilingual Education), Spatial Information Practice, College English training（1-8）, GIS-based Application Skills, Remote Sensing Application Prospect, etc.
	10.3 Have the ability of cross-cultural communication in language and writing, and be able to communicate and exchange geospatial information issues in a cross-cultural context.	College English(1-2), Academic Writing (Bilingual Education), College English training（1-8）, etc.
11. Project management: Understand and master the method of development and management for economic decision method and application in multi subject environment.	11.1 Master the management and economic decision-making methods involved in engineering projects.	Programming and Development of GIS，The Principle of Geographic Information System (Bilingual Education)，Undergraduate Design or Thesis, etc.
	11.2 Understand the cost structure of GIS production and the engineering management and economic decision-making issues involved.	Programming and Development of GIS，The Principle of Geographic Information System (Bilingual Education)，Undergraduate Design or Thesis, etc.

Graduate Abilities	Related Knowledge	Course Supports
	11.3 Be able to use engineering management and economic decision-making methods in the process of design and development in a multidisciplinary environment.	Spatial Information Practice, Immovable Property Measurement and Management Practice, Programming and Development of GIS, Urban geography, Undergraduate Design or Thesis, etc.
12. Lifelong learning: Have the awareness of autonomous learning and lifelong learning and the ability to learn, and adapt to the development.	12.1 Have the awareness of autonomous learning and lifelong learning.	Thought Morals Accomplishment and Basic Law, College Student Occupation Career and Development Planning, College English(1-2), Introduction to Geomatics, Fundamentals of Error Theory and Surveying Adjustment, Surveying and Mapping Management and Laws, Advanced Technology of Surveying, Aping and GIS, College English training （1-8）, etc.
	12.2 Have the ability to learn, and adapt to the development.	The Generality of Basic Principle of Marxism , Introduction to Mao Zedong Thought and Theoretical System of Socialism with Chinese Characteristics, Introduction to Geomatics, Academic Writing (Bilingual Education), Introduction to Smart City , Advanced Technology of Surveying, Undergraduate Design or Thesis, Innovative Practice (Surveying and Mapping Skills Contest，Surveying and Mapping Science and Technology Paper Contest, GIS Skills Competition), etc.

表 1　地理空间信息工程专业指导性教学计划（1）

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续学时	开课学期	教学单位
通识教育课	必修	思想道德与法治 Ideological Morality and Rule of Law	3	48	48					1	马克思主义学院
		中国近现代史纲要 The Outline of the Modern Chinese History	3	48	32			16		2	马克思主义学院
		习近平新时代中国特色社会主义思想概论 Introduction to Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era	3	48	48					2	马克思主义学院
		习近平新时代中国特色社会主义思想在京华大地的生动实践 The Vivid Practice of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era in Beijing	0.5	8	8					2	马克思主义学院
		马克思主义基本原理★ Basic Principle of Marxism	3	48	48					3	马克思主义学院
		毛泽东思想和中国特色社会主义理论体系概论★ Introduction to Mao Zedong Thoughts and Theoretical System of Socialism with Chinese Characteristics	3	48	48					4	马克思主义学院
		形势与政策（1-4） Situation and Policy(1-4)	2	32	32					1-4	马克思主义学院
		大学生职业生涯与发展规划 College Student Occupation Career and Development Planning	1	16	16					1	学工部
		大学生心理健康 The Mental Health of College Students	1	16	16					2	学工部
		大学英语(1-2) ★ College English(1-2)	6	128	96				32	1-2	人文学院
		大学英语拓展系列课程（1-4） College English Training（1-4）	2	32	32					3	人文学院
		大学英语拓展系列课程（5-8） College English Training（5-8）	2	32	32					4	人文学院
		体育(1-4) Physical Education(1-4)	4	120	120					1-4	体育部
		计算思维导论 Introduction to Computational Thinking	1.5	56	24			32		1	电信学院
		“四史”（党史、新中国史、改革开放史、社会主义发展史） History of the Communist Party of China, History of New China, History of Reform and Opening up and History of Socialist Development	0.5	8	8					1-7	马克思主义学院
		小 计	35.5	688	608			48	32		
	核心	特色课程与人文素养	2	32						1-8	各院部
		经典研读与文化传承	2	32						1-8	各院部
		科技文明与城市发展	2	32						1-8	各院部
		建筑艺术与审美教育	2	32						1-8	各院部
		修读 4 类合计 8 学分，每类至少修读 2 学分									
	任选	工程实践类	1-8 学期任选								各院部
		复合培养类	1-8 学期任选								各院部
		任选至少修读 2 学分									
	通识教育课合计至少修读 45.5 学分。 其中通识教育必修 35.5 学分（含“四史”（党史、新中国史、改革开放史、社会主义发展史），四选一，1-7 学期内任意学期完成，0.5 学分），通识教育核心 8 学分，通识教育任选 2 学分（含体育类课程 1 学分）。										

表 1　地理空间信息工程专业指导性教学计划（2）

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
大类基础课	必修	高等数学 A（1）★ Advanced Mathematics A(1)	5	92	80				12	1	理学院
		高等数学 A（2）★ Advanced Mathematics A(2)	5	84	80				4	2	理学院
		线性代数 Linear Algebra	2	40	32				8	2	理学院
		概率论与数理统计 B　Theory of Probability and Statistics (B)	3	48	44				4	3	理学院
		普通物理 A（1）★　College physics A(1)	3	56	52			4		2	理学院
		普通物理 A（2）★　College physics A(2)	3	56	52			4		3	理学院
		物理实验（1-2）Physics Experiment(1-2)	2	60		60				3-4	理学院
		C 语言程序设计★ C Language Programming	2	32	24	8				1	地理信息科学系
		地球科学概论 Introduction to Geoscience	2	32	32					1	地理信息科学系
		测绘地理信息概论 Introduction to Geomatics	1	16	16					1	测绘学院
		CAD 基础与应用 CAD Basic and Application	2	32	16	16				1	测绘工程系
		数字地形测量学★ Digital Topographic Surveying	4	64	52	12				2	测绘工程系
		地图学 Cartography	3	48	40	8				3	地理信息科学系
		地理信息系统原理(双语) The Principle of Geographic Information System(Bilingual Education)	3	48	40	8				3	地理信息科学系
		遥感原理与应用 Principles of Remote Sensing	3	48	48					3	遥感工程系
		合　计	43	756	608	112		8	28		
	选修	GIS 基础应用技能 GIS-based Application Skills	1	16	8	8				2	地理信息科学系
		现代测绘技术应用 Modern　Surveying and Mapping Technology　Application	1	16						2	测绘工程系
		遥感应用前景 Remote Sensing Application Prospect	1	16						3	遥感工程系
	大类学科基础课合计 44 学分，必修 43 学分，任选 1 学分										

表 1　地理空间信息工程专业指导性教学计划（3）

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
专业核心课	必修	空间数据库 Spatial Database	3	48	32	16				4	地理信息科学系
		误差理论与测量平差基础★ Fundamentals of Error Theory and Surveying Adjustment	2	32	32					4	测绘工程系
		空间分析与建模 Spatial Analysis and Modeling	3	48	40	8				5	地理信息科学系
		地理信息系统设计与开发 Programming and Development of GIS	3	48	24	24				5	地理信息科学系
		WebGIS 技术与开发 WebGIS Technology and Development	3	48	24	24				6	地理信息科学系
		城市空间信息学 Urban Spatial Information Science	2	32	24	8				7	地理信息科学系
		小计	16	256	176	80					
		专业核心课合计必修 16 学分									
专业方向课	必修	C#程序设计 C# Programming	3	48	32	16				4	地理信息科学系
		GNSS 原理及其应用 The Application and Principles of GNSS	2	32	28	4				5	测绘工程系
		测绘管理与法律法规 SurveyingManagement and Laws	1	16						6	测绘学院
		小计	6	96	60	20					
	选修	摄影测量学 Photogrammetry（限选）	3	48	44	4				5	遥感工程系
		人工智能在地理信息系统中的应用 Application of Artificial Intelligence in GIS（限选）	1.5	24	16	8				5	地理信息科学系
		数据结构 Data Structure（限选）	2	32	24	8				5	地理信息科学系
		遥感数字图像处理（限选） Remote Sensing Image Processing	1.5	24	16	8				5	遥感工程系
		计算机图形学 Computer Graphics（限选）	2	32	20	12				6	地理信息科学系
		工程制图与识图 Engineering Drawing and Read Drawing（限选）	3	48	48					6	理学院
		大数据与地理信息系统 Big Data and Geographic Information System（限选）	1.5	24	16	8				6	地理信息科学系
		CIM 技术与应用 CIM Technology and Application（限选）	1.5	24	16	8				7	地理信息科学系
		城市地理学 Urban geography（限选）	2	32	32					7	地理信息科学系
		地图设计与编绘 Map Design and Compilation	2	32	16	16				4	地理信息科学系
		Java 程序设计 Java Programming	2	32	24	8				6	地理信息科学系
		人文地理学 Human Geography	1.5	32	16	16				5	地理信息科学系

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
		遥感软件 Remote Sensing Software	2	32	16	16				5	遥感工程系
		Python 语言 Python language	2	32	24	8				4	地理信息科学系
		地理信息环境与健康（双语） GIS, Environment & Health	1.5	24	16	8				5	地理信息科学系
		科技论文写作（双语） Academic Writing (Bilingual Education)	1	16	16					6	遥感工程系
		科技文献检索 Document Retrieval of Science and Technology	1	16	16			8		7	图书馆
		GIS 应用（双语） GIS Applications (Bilingual Education)	1.5	24	16	8				6	地理信息科学系
		三维地理信息技术 Technology of 3D GIS	2	32	16	16				6	地理信息科学系
		遥感技术应用 Applications of Remote Sensing Technology	2	32	16	16				6	遥感工程系
		移动 GIS 开发 Mobile GIS Development	2	32	16	16				7	地理信息科学系
		激光雷达测量技术与应用 Laser Radar Surveying Technology and Application	2	32	24	8				6	地理信息科学系
		测绘地理信息技术前沿 Advanced Technology of Surveying, Mapping and GIS	1	16	16					7	测绘学院
		智慧城市导论 Introduction to Smart City	1	16	16					6	地理信息科学系
		城市遥感(双语)Urban Remote Sensing(Bilingual Education)	2	32	24	8				6	遥感工程系
		城市规划概论 Conspectus of Urban Planning	1.5	24	20	4				7	建筑学院
		市场营销 Marketing Management	1.5	24	24					7	经管学院
		自然资源管理 Natural Resources Management	1.5	24						7	测绘学院
		小计	49	792	564	204		8			
	专业方向课合计 26 学分，必修 6 学分，任选 20 学分										

表 2　地理空间信息工程专业指导性教学计划（实践环节）

课程属性	课程名称		学分	折合学时	实验实践	上机	开课学期	开设周次	教学单位
课内	军事理论 Military Theory		2	36			1	1-3	武装部
	军训 Military Training		2	112					
	形势与政策（5-8）Situation and Policy(5-8)		-	32			5-8	分散	马克思主义学院、各学院
	劳动教育（1-2） Labor Education(1-2)		1	32			3、7	分散	学工部、各院部
	数字地形测量实习 Digital Topographic Surveying Practice		3	60	60		2	18-20	测绘工程系
	地图学实习 Cartography Practice		2	40			3	17-18	地理信息科学系
	地理信息系统原理实习 The Principle of Geographic Information System Practice		2	40			3	19-20	地理信息科学系
	C#程序实习 C# Programming Practice		2	40			4	18-19	地理信息科学系
	空间数据库实习 Spatial Database Practice		2	40			4	20	地理信息科学系
	遥感原理与应用实习 Principles of Remote Sensing Practice		1	20			4	17	遥感工程系
	地理信息系统设计与开发实习 Programming and Development of GIS Practice		2	40			5	19-20	地理信息科学系
	摄影测量基础实习 Photogrammetry Fundamental Practice		1	20			5	18	遥感工程系
	空间分析与建模实习 Spatial Analysis and Modeling Practice		1	20			5	17	地理信息科学系
	自然地理地貌及遥感图像解译实习 Natural Geography and Remote Sensing image interpretation Practice		1	20	20		6	15	遥感工程系
	空间信息综合实习 Spatial Information Practice		5	100	100		7	1-5	测绘学院
	毕业设计或论文 Undergraduate Design or Thesis		8	160	160		8	1-16	地理信息科学系
	合计		35	812	340				
课外	创新实践及科研训练	GIS 软件开发大赛实训 GIS Software Development Competition Practical Training	1	20	20		4		地理信息科学系
		学院 GIS 选拔比赛 School GIS Selection Competition	1	20	20		5		地理信息科学系
		全国大学生 GIS 应用技能大赛 National University GIS Application Skills Contest	1	20	20				地理信息科学系
		超图开发大赛　SuperMap Development Competition	1	20	20				地理信息科学系
		天地图开发大赛 Map World Development Competition	1	20	20				地理信息科学系

课程属性	课程名称		学分	折合学时	实验实践	上机	开课学期	开设周次	教学单位
		则泰杯全国论文大赛 The Mostrule Cup State Essay Competition	1	20	20				地理信息科学系
		Mapgis 开发大赛 Mapgis Development Competition	1	20	20				地理信息科学系
		测绘技能大赛实训 Surveying and Mapping Skills Practice Contest	2	40	40		4		测绘工程系
		学院测绘技能大赛 School of Surveying and Mapping Skills Contest	1	20	20		4		测绘工程系
		测量数据处理与程序设计大赛实训 Surveying Data Processing and Program Design Practice Contest	1	20	20		5		测绘工程系
		遥感科学与技术创新实践及科研训练	2	40	40		6		遥感工程系
	小 计		13	260					
实践环节合计 37 学分，课内必修 35 学分，创新实践及科研训练选修 2 学分									

2022 级遥感科学与技术专业本科培养方案

一、专业基本信息

英文名称	Remote Sensing Science and Technology		
专业代码	081202	学科门类	工学
学　　制	四年	授予学位	工学学士

二、培养目标及特色

培养目标:

面向首都及周边城市群建设的需要，培养德智体美劳全面发展的社会主义事业合格建设者和可靠接班人，掌握遥感科学与技术专业知识，具有人文素质、职业道德和社会责任感，能够在城乡建设与规划、自然资源调查与监测、智慧城市建设与运营、建筑文化遗产保护、建/构筑物健康监测及城市基础测绘等领域从事地面、航空、航天遥感信息采集与处理、分析、应用开发及项目管理方面工作的高级专业骨干人才。

毕业后经过 5 年左右的工作和学习，能够达到如下目标:

（1）具有良好的思想道德修养、科学文化素养和工作责任心，能够自觉承担和履行社会责任，能积极服务国家和社会。

（2）胜任摄影测量与遥感方面的生产、设计与开发、规划与管理，以及相关方面的研究与教育工作。

（3）具有组织管理与协调能力，良好的团队意识、国际化视野和沟通能力，能解决复杂遥感工程问题并在多学科背景下担任团队成员和负责人的角色。

（4）具有终身学习和跟随遥感领域新技术发展的能力，掌握现代工具、软件的使用方法，具有竞争潜力。

（5）具备测绘地理信息行业工程师的能力，成为遥感领域相关企事业单位的技术负责人或技术骨干。

专业特色:

本专业依托首都建设、学校土木建筑类学科和学院测绘学科背景优势，在中、高分辨率地理要素提取与城市环境及设施监测、建筑遗产精细重构与虚拟修复等方面具有突出优势和特色。注重扎实的摄影测量与遥感体系课程的贯穿和建设。着力培养学生的两个能力：第一，在各个教学环节注重“原创能力”，强调“计算机实践能力”。第二，确保学生具有摄影测量遥感的生产实践能力。

三、主干学科

测绘科学与技术

四、主干课程

1．主干基础课程

测绘地理信息概论、数字地形测量学、C 语言程序设计、地球科学概论、地图学

2．主干专业课程

遥感原理与应用、航空航天数据获取、摄影测量学、遥感数字图像处理、城市遥感（双语）、计算机视觉

五、主要实践教学环节

数字地形测量学实习、摄影测量学实习、计算机视觉实习、遥感原理与应用实习、遥感数字图像处理实习、遥感综合实习、自然地理地貌及遥感图像解译实习、（近景与激光雷达、移动测量、微波遥感）新技术综合实习、地理信息系统原理实习、空间信息综合实习、毕业设计。

六、毕业学分要求

参照北京建筑大学本科学生学业修读管理规定及学士学位授予细则，修满本专业最低计划学分应达到 170.5 学分，其中理论课程 130.5 学分，实践教学环节 40 学分。

七、各类课程结构比例

课程类别	课程属性	学分	学时	学分比例
通识教育课	必修	43.5	736	25.51%
	选修	2	32	1.17%
大类基础课	必修	43	756	25.22%
	选修	1	16	0.59%
专业核心课	必修	14	224	8.21%
专业方向课	必修	6	96	3.52%
	任选	21	336	12.32%
独立实践环节	必修	38	872	22.29%
	选修	2	40	1.17%
总计		170.5	3108	100%

八、教学进程表

学期	教学周	考试	实践	学期	教学周	考试	实践
1	4-19 周	20 周	1-3 周	2	1-16 周	17-周	18-20 周
3	1-15 周	16 周	17-20 周	4	1-16 周	17 周	18-20 周
5	1-16 周	17 周	18-20 周	6	1-15，18-19 周	20 周	16-17 周
7	6-14 周	15 周	1-5、16-20 周	8	1-16 毕业设计/实习 17 周答辩		

九、毕业生应具备的知识能力及实现矩阵

毕业生应具备的知识能力	相关毕业要求指标点	实现途径（课程支撑）
1. 工程知识: 能够应用数学、物理、计算机、地学科学、工程的基础和专业知识用于解决遥感领域复杂工程问题。	1.1 能够将数学、物理、地学科学、工程的语言工具用于遥感工程问题的表述	高等数学 A(1-2)、概率论与数理统计 B、普通物理 B(1-2)、遥感原理与应用、遥感数字图像处理等。
	1.2 能针对具体的遥感对象建立数学模型并求解 ，满足测绘的精度要求	高等数学 A(1-2)、线性代数、普通物理 B(1-2)、摄影测量学、大地测量学基础、误差理论与测量平差基础等。
	1.3 能够将遥感相关知识和数学模型方法用于推演、分析遥感专业复杂工程问题	线性代数、遥感数字图像处理、地理信息系统原理（双语）、GNSS 原理及其应用、计算机视觉等。
	1.4 能够将遥感相关知识和数学模型方法用于遥感专业复杂工程问题解决方案的比较与综合	概率论与数理统计 B、数据结构、遥感技术应用、摄影测量学、数字地形测量学实习等。
2.问题分析: 能够应用数学、物理、计算机、地学科学和工程的基本原理，识别、表达、并通过文献研究分析复杂遥感工程问题，以获得有效结论。	2.1 能够将数学、物理、计算机、地学科学和工程的基本理论运用到识别判断遥感复杂工程问题的关键环节	计算思维导论、高等数学 A(1-2)、概率论与数理统计 B 普通物理 B(1-2) CAD 基础与应用、地图学、面向对象的程序设计、遥感数字图像处理等。
	2.2 能够运用数学、物理、计算机、地学科学和工程的基本理论分析与表达遥感复杂工程问题	遥感技术应用、城市遥感（双语）、面向对象的程序设计等。
	2.3 能够认识到解决问题有多种方案可选 择，会通过文献研究寻求可替代的解决方案	科技文献检索、GNSS 原理及其应用、摄影测量学、遥感原理与应用、毕业设计等。
	2.4 能运用数学、物理、计算机、地学科学和工程的基本原理，借助文献研究，分析遥感复杂工程过	概率论与数理统计、遥感原理与应用、地理信息系统原理实习、毕业设计等。

毕业生应具备的知识能力	相关毕业要求指标点	实现途径（课程支撑）
	程中的影响因素，获得有效结论	
3. 设计/开发解决方案:能够设计针对复杂遥感、摄影测量、测绘工程问题的解决方案，设计满足遥感数据获取、处理、应用等方面需求的系统、生产流程，并能够在设计环节中体现创新意识,考虑社会、健康、安全、法律、文化以及环境等因素。	3.1 能够根据测绘、遥感、地理信息工程用户的需求，设计技术方案，了解影响设计目标和技术方案的各种因素	C 语言程序设计、遥感数字图像处理、遥感软件、可视化语言 IDl、GIS 软件使用、遥感数字图像处理实习、空间信息综合实习等。
	3.2 能够开发满足遥感数据获取、处理、应用等方面需求的生产流程及算法	GNSS 原理及其应用、激光雷达测量技术与应用、地理信息系统原理实习、面向对象的程序设计实习、遥感数字图像处理实习等。
	3.3 能够在遥感工程解决方案设计中体现创新意识	遥感技术应用、计算机视觉实习、毕业设计等。
	3.4 能够在遥感工程解决方案设计中考虑社会、健康、安全、法律、文化以及环境等因素	航空航天数据获取、遥感图像解译、思想道德与法治
4.研究：能够基于科学原理并采用科学方法对复杂遥感工程问题进行研究，包括现状调研、获取分析与解释数据、并通过信息综合得到合理有效的结论。	4.1能够运用科学原理及文献研究等方法对复杂遥感工程问题现状进行调研	遥感原理与应用、摄影测量学、遥感数字图像处理等。
	4.2能够基于专业理论知识对研究方案进行设计、论证与预测	GNSS 原理及其应用、遥感原理与应用实习、地理信息系统原理（双语）等。
	4.3能够采用科学方法实施数据采集与分析处理	激光雷达测量技术与应用、航空航天数据获取、空间信息综合实习等。
	4.4能够对实验结果进行信息综合与评判，取得合理有效结论	近景摄影测量、数字地形测量实习、地图学实习等。
5. 使用现代工具：能够针对复杂遥感工程问题，开发、选择与使用恰当的遥	5.1 能够针对复杂遥感工程问题，选择恰当的现代遥感技术与硬件、软件并	微波遥感、摄影测量学实习、遥感综合实习、（近景与激光雷达、移动测量、微波遥感）新技术实习等。

毕业生应具备的知识能力	相关毕业要求指标点	实现途径（课程支撑）
感、测绘技术与资源；现代测绘仪器和遥感处理软件，能够对复杂遥感工程问题的预测与模拟，并能够理解其局限性。	理解其局限性	
	5.2 能够使用现代测绘仪器和信息技术软件完成遥感 数据采集、数据处理与精度分析	微波遥感、误差理论与测量平差基础、航空航天数据获取、遥感原理与应用实习等。
	5.3 能够使用现代工具，对复杂 遥感 工程问题进行预测与模拟，并理解其局限性	误差理论与测量平差基础、计算机视觉、新技术实习、深度学习与遥感智能解译等。
6. 工程与社会：能够基于工程相关背景知识进行合理分析，评价遥感工程实践和复杂工程问题解决方案对社会、健康、安全、法律以及文化的影响，并理解应承担的责任。	6.1 熟悉遥感专业相关技术标准、法律法规及管理规定，并能够理解其对项目实施的影响	测绘管理与法律法规、思想道德与法治、数字地形测量学、遥感原理与应用等。
	6.2 能够评价遥感测绘成果对社会、健康、法律以及文化、国家安全、领土完整的重要性，以及这些制约因素对项目实施的影响，并理解应承担的责任理解遥感工程实践应承担的责任	空间信息综合实习、遥感综合实习、毕业设计等。
7. 环境和可持续发展：能够发现和分析针对复杂遥感工程问题的测绘工程实践对环境、社会可持续发展的影响。	7.1 知晓和理解环境保护和可持续发展的理念和内涵	习近平新时代中国特色社会主义思想概论、测绘地理信息概论、地球科学概论、自然地理地貌与遥感解译实习等。
	7.2 能够从环境保护和可持续发展的角度认知遥感 工程实践活动的可持续性，以及分析遥感 工程生产实践中可能对环境及社会造成的损害和隐患	地球科学概论、自然地理地貌与遥感解译实习、毕业设计等。
8. 职业规范：具有人文社会科学素养、社会责任感，能够在遥感工程实践中理	8.1 具有人文社会科学素养 和健康的体魄，树立正确的世界观、人生观和	思想道德与法治、习近平新时代中国特色社会主义思想概论、马克思主义基本原理、体育（1-4）、劳动教育等。

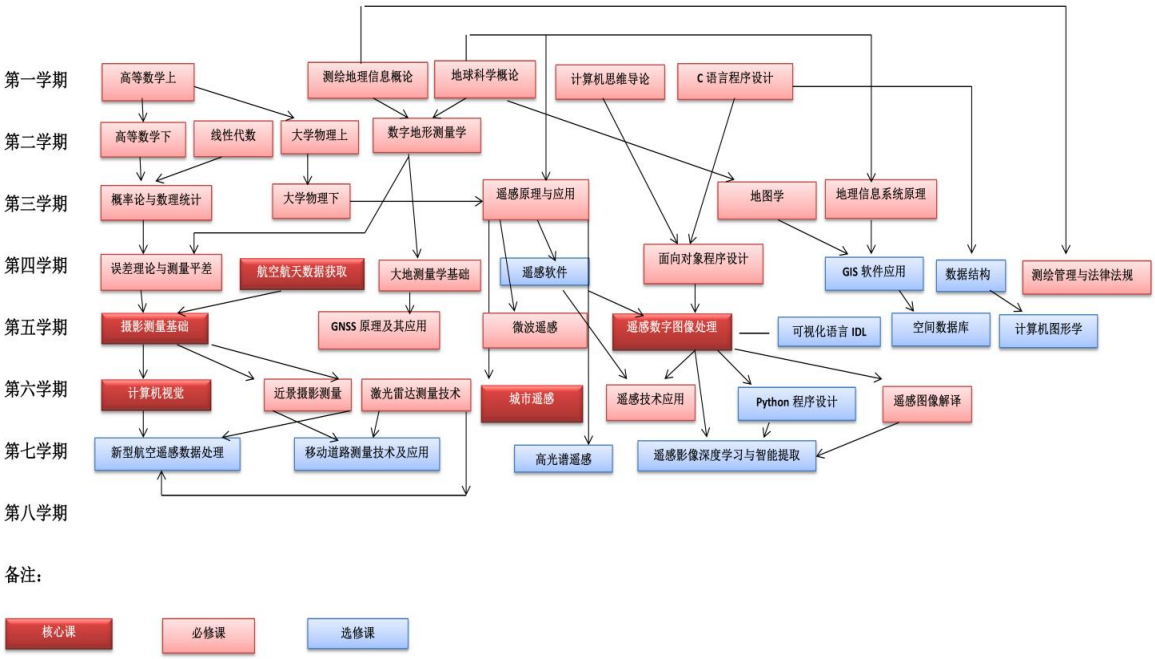
毕业生应具备的知识能力	相关毕业要求指标点	实现途径（课程支撑）
解并遵守测绘、地理信息行业职业道德和规范，履行责任。	价值观	
	8.2 理解诚实公正、诚信守则的遥感行业职业道德和规范，并能在遥感工程实践中自觉遵守	大学生职业生涯与发展规划、形势与政策（1-2）遥感综合实习等。
	8.3 理解遥感工作人员对公众的安全、健康、福祉、环境保护的社会责任，能够在遥感工程实践中自觉履行责任	大学生心理健康、数字地形测量学、自然地理地貌及遥感图像解译实习等。
9. 个人和团队：能够在多学科背景下的团队中承担个体、团队成员以及责任人的角色。	9.1 能与测绘、地理信息、计算机、建筑历史与理论、地理等学科的成员有效沟通，合作共事	工程制图与识图、地球科学概论、计算机视觉、面向对象的程序设计、自然地理地貌及遥感图像解译实习等。
	9.2 能够在团队中独立或合作开展工作	近景摄影测量、数字地形测量实习、新技术实习等。
	9.3 能够组织、协调和指挥团队开展工作	军训、面向对象程序设计、空间信息综合实习、学院测绘技能大赛等。
10. 沟通：能够就复杂遥感工程问题与行及社会公众进行有效沟通和交流，包括撰写报告和设计文稿、陈述发言、清晰表达或回应指令，并具备一定的国际视野，能够在跨文化背景下进行沟通和交流。	10.1 能够就遥感专业问题，以口头、文稿、图表等方式，准确表达自己的观点，回应质疑，理解与同行和社会公众交流的差异性。	城市遥感（双语）、科技论文写作（双语）、空间信息综合实习、遥感综合实习等。
	10.2 具备一定的国际视野，了解遥感领域的国际前沿发展趋势和研究热点，理解和尊重世界不同文化的差异性和多样性。	大学英语（1-2）、测绘地理信息概论、地理信息系统原理（双语）、遥感综合实习等。
	10.3 具有跨文化交流的语言和书面表达能力，能够就遥感问题在跨文化背景下进行沟通和交流	大学英语（1-2）、科技论文写作（双语）、城市遥感（双语）、毕业设计等。

毕业生应具备的知识能力	相关毕业要求指标点	实现途径（课程支撑）
11.项目管理：理解并掌握遥感工程项目或产品的设计和实施的全周期、全流程管理原理与经济决策方法，并能在多学科环境中应用。	11.1 掌握工程项目中涉及的管理与经济决策方法	数字地形测量学实习、测绘管理与法律法规、（近景与激光雷达、移动测量、微波遥感）新技术实习等。
	11.2 了解遥感、测绘工程及产品全周期、全流程的成本构成，能在多学科环境下，理解其中涉及的工程管理与经济决策问题	现代测绘技术应用、测绘管理与法律法规、航空航天数据获取、遥感综合实习、毕业设计等。
	11.3 能在多学科环境下，在设计开发遥感工程解决方案的过程中，运用工程管理与经济决策方法。	遥感技术应用、现代测绘技术应用、（近景与激光雷达、移动测量、微波遥感）新技术实习、测绘管理与法律法规等。
12. 终身学习：具有自主学习和终身学习遥感领域新知识的意识，有不断学习和适应遥感技术发展的能力。	12.1 具有自主学习和终身学习的意识，掌握必要的学习方法	大学生职业生涯与发展规划、计算机思维导论、科技革命与社会发展、数字地形测量学、遥感应用前景等。
	12.2 具有理解和迁移知识、识别和综述遥感学科新发展的能力	大学英语（1-2）、测绘地理信息概论、遥感影像深度学习与智能解译、毕业设计、遥感科学与技术创新实践及科研训练等。

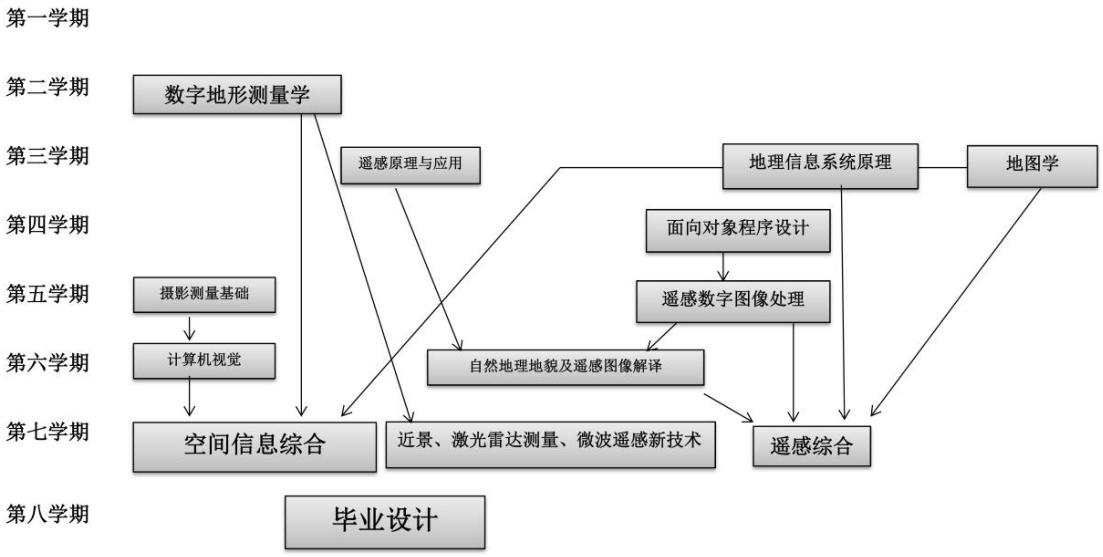
十、指导性教学计划（见附表）

十一、主要课程、实践环节逻辑关系结构图

1、主要课程



2、主要实践环节



备注：字体大小与实践环节时长对应

2022 Undergraduate Program for Specialty in Remote Sensing Science and Technology

I Specialty Name and Code

English Name	**Remote Sensing Science and Technology**		
Code	081202	Disciplines	Bachelor of Engineering
Length of Schooling	4 years	Degree	Bachelor of Engineering

II Educational Objectives and Features

Objectives: To meet the needs of the capital and the country's urban and rural construction, train qualified builders and reliable successors of the socialist cause with all-round development of morality, intelligence, physique, beauty and labor, and be able to engage in ground, aviation and aerospace in the fields of land and resources survey, National basic surveying and mapping, urban and rural construction and planning, natural resources monitoring, environmental protection, cultural heritage protection, disaster early warning and emergency response, etc Remote sensing information collection and processing, analysis, application development and project management of senior professional backbone personnel.

After five years of work and study after graduation, we can achieve the following goals:

(1) With good ideological and moral cultivation and scientific and cultural literacy, strong sense of responsibility, dedication, good professional ethics, can undertake and perform social responsibility, can actively serve the country and society.

(2) Competent in photogrammetry and remote sensing production, design and development, planning and management, as well as related research and education.

(3) Have a good sense of international vision and ability to solve complex engineering problems.

(4) It has the ability of lifelong learning and following the development of new technology in remote sensing field, mastering the use method of modern tools and software, and has competitive potential.

(5) With the ability of Surveying and mapping geographic information industry engineer, become the technical director or technical backbone of relevant enterprises and institutions in the field of remote sensing.Professional features: Relying on the background advantages of capital construction and civil architecture discipline of the University and surveying and mapping discipline of the college, this major has outstanding advantages and characteristics in the aspects of medium and high resolution geographical elements extraction and urban environment and facilities monitoring, fine reconstruction and virtual restoration of architectural heritage. Pay attention to the penetration and construction of photogrammetry and remote sensing system course. First, we should pay attention to "original ability" and "computer practice ability" in every teaching link. Second, to ensure that students have the production practice ability of photogrammetry and remote sensing.

III Major Disciplines

1. Main basic courses

Introduction to surveying and mapping geographic information, digital topographic survey, C language, introduction to earth science, cartography

2. Major courses

Remote sensing principle and application, aerospace data acquisition, photogrammetry, remote sensing digital image processing, urban remote sensing (Bilingual), computer vision

IV Major Practical Training

Digital topographic surveying practice, photogrammetry practice, computer vision practice, remote sensing principle practice, remote sensing digital image processing practice, remote sensing comprehensive practice, natural geography and landform and remote sensing image interpretation practice, (close range and lidar, mobile measurement, microwave remote sensing) new technology comprehensive practice, geographic information system principle practice, spatial information comprehensive practice, graduation Design

V Graduation Requirements

In accordance with "Management Regulations for the Undergraduate Students of Beijing University of Civil Engineering and Architecture" and "Bachelor's Degree Awarding Regulations", the minimum credits required by specialty for graduate is 170.5, including 130.5 credits of theoretical courses and 40 credits of practice teaching.

VI Proportion of Course

Course Category	Course Type	Credits	Class Hour	Proportion
General Education	Compulsory	43.5	736	25.51%
	Optional	2	32	1.17%
Big Academic Subjects	Compulsory	43	756	25.22%
	Optional	1	16	0.59%
Professional Core	Compulsory	14	224	8.21%
Professional Direction	Compulsory	6	96	3.52%
	Optional	21	336	12.32%
Practice	Compulsory	38	872	22.29%
	Optional	2	40	1.17%
Total		170.5	3108	100%

VII Table of Teaching Arrangement

Semester	Teaching	Exam	Practice	Semester	Teaching	Exam	Practice
1	4-19	20	1-3	2	1-16	17	18-20
3	1-15	16	17-20	4	1-16	17	18-20
5	1-16	17	18-20	6	1-15，18-19	20	16-17
7	6-14	15	1-5、16-20	8	1-16 weeks for graduation project / Internship, 17 week oral defense		

VIII Graduate Abilities and Matrices

Graduate Abilities	Related Knowledge	Course Supports
1. Engineering knowledge: Engineering knowledge: be able to apply the basic and professional knowledge of mathematics, physics and Geosciences to solve complex engineering problems.	1.1 be able to use the language tools of mathematics, physics and geosciences for the expression of remote sensing engineering problems:	Advanced Mathematics A (1-2), probability and Mathematical Statistics B, linear algebra, General Physics B (1-2), remote sensing principle and application, remote sensing digital image processing, etc.
	1.2 be able to build mathematical model for specific remote sensing objects	Advanced Mathematics A (1-2), linear algebra, General Physics B (1-2), photogrammetry, Fundamentals of geodesy, error theory and survey adjustment, etc.
	1.3 be able to apply the relevant knowledge and mathematical model methods to deduce and analyze the complex engineering problems of remote sensing	Linear algebra, remote sensing digital image processing, geographic information system principle (Bilingual), GNSS principle and its application, computer vision, etc.
	1.4 be able to apply relevant knowledge and mathematical model methods to the comparison and synthesis of solutions to complex engineering problems of remote sensing	Probability and Mathematical Statistics B, data structure, application of remote sensing technology, photogrammetry, digital topographic survey practice, etc.
2. Problem analysis: be able to apply the basic principles of mathematics, physics	2.1 be able to apply the basic theories of mathematics, physics and Geosciences to identification, analysis and	Introduction to computational thinking, advanced mathematics a (1-2), probability and Mathematical Statistics B, General Physics B (1-2) CAD foundation and

Graduate Abilities	Related Knowledge	Course Supports
and Geosciences to identify, express and analyze complex remote sensing engineering problems through literature research, so as to obtain effective conclusions.	expression.	application, cartography, object-oriented programming, remote sensing digital image processing, etc.
	2.2 be able to correctly express complex remote sensing engineering problems based on relevant scientific principles and mathematical model methods	Application of remote sensing technology, urban remote sensing (Bilingual), object-oriented programming, etc.
	2.3 be able to recognize that there are many options for solving problems, and be able to find alternative solutions through literature research	Scientific and technological literature retrieval, close range photogrammetry, remote sensing technology application, new technology practice, graduation design, scientific research training, etc.
	2.4 be able to use the basic principles of mathematics, physics, computer, geoscience and engineering, analyze the influencing factors in the process of remote sensing complex engineering with the help of literature research, and obtain effective conclusions	Probability theory and mathematical statistics, remote sensing principle and application, geographic information system principle practice, graduation project, etc.
3. Design/Develop solutions: be able to design solutions for complex remote sensing and photogrammetric surveying and mapping engineering problems, design systems and production processes that meet specific needs, embody	3.1 master the basic design / development methods and technologies of Surveying and mapping geographic information engineering design / development in the whole cycle and process, and understand the various factors that affect the design objectives and technical solutions.	C language programming, remote sensing digital image processing, remote sensing software, visualization Language IDL, GIS software use, remote sensing digital image processing practice, spatial information comprehensive practice, etc.
	3.2 be able to design and develop production processes	GNSS principle and its application, lidar measurement technology and application,

Graduate Abilities	Related Knowledge	Course Supports
innovation awareness in the design process, and consider social, health, safety, legal, cultural and environmental factors.	and systems that meet specific remote sensing needs	GIS principle practice, object-oriented programming practice, remote sensing digital image processing practice, etc.
	3.3 be able to embody the innovative consciousness in the design of remote sensing engineering solutions, and consider the social, health, safety, legal, cultural and environmental factors.	Remote sensing technology application, computer vision practice, graduation project, etc.
	3.4 be able to consider social, health, safety, legal, cultural and environmental factors in the design of remote sensing engineering solutions	Aerospace data acquisition, remote sensing image interpretation, ideological and moral cultivation and legal basis
4. Research: be able to research complex remote sensing engineering problems based on scientific principles and scientific methods, including designing experiments, analyzing and interpreting data, and getting reasonable and effective conclusions through information integration.	4.1 be able to use scientific principles to put forward research plans for complex remote sensing engineering problems	Remote sensing principle and application, photogrammetry, remote sensing digital image processing, etc.
	4.2 be able to design, demonstrate and predict the research scheme based on professional theoretical knowledge	GNSS principle and its application, remote sensing principle and application practice, geographic information system principle (Bilingual), etc.
	4.3 be able to use scientific methods to implement data collection, analysis and processing	Lidar measurement technology and application, aerospace data acquisition, comprehensive practice of spatial information, etc.
	4.4 be able to carry out information synthesis and evaluation on the experimental results, and obtain reasonable and effective conclusions	Close range photogrammetry, digital topographic survey practice, cartography practice, etc.
5. Using modern tools: be able to develop,	5.1 be able to select appropriate modern remote	Microwave remote sensing, photogrammetry practice, comprehensive

Graduate Abilities	Related Knowledge	Course Supports
select and use appropriate remote sensing, mapping technology, resources, modern mapping instruments and remote sensing processing software for complex remote sensing engineering problems, including prediction and Simulation of complex remote sensing engineering problems, and understand their limitations.	sensing technology and hardware, software	remote sensing practice, (close range and lidar, mobile measurement, microwave remote sensing) new technology practice, etc.
	5.2 be able to use modern surveying and mapping instruments and information technology software to complete remote sensing data collection, data processing and accuracy analysis	Microwave remote sensing, error theory and measurement adjustment basis, aerospace data acquisition, remote sensing principle and application practice, etc.
	5.3 be able to use modern tools to predict and simulate complex remote sensing engineering problems, and understand their limitations	Error theory and measurement adjustment basis, computer vision, new technology practice, deep learning and intelligent interpretation of remote sensing, etc.
6. Society and engineering: be able to conduct reasonable analysis based on relevant background knowledge of the project, evaluate the impact of remote sensing engineering practice and complex engineering problem solutions on society, health, safety, law and culture, and understand the responsibilities to be undertaken	6.1 be familiar with relevant technical standards, laws and regulations and management regulations of remote sensing specialty, and be able to conduct reasonable analysis based on relevant background knowledge of the project	Surveying and mapping management and laws and regulations, ideological and moral cultivation and legal basis, digital topographic survey, remote sensing principle and application, etc.
	6.2 be able to evaluate the social, health, safety, legal and cultural impact of remote sensing engineering practice and complex mapping engineering solutions, and the impact of these constraints on project implementation, and understand the responsibilities to be undertaken	Comprehensive practice of spatial information, comprehensive practice of remote sensing, graduation project, etc.

Graduate Abilities	Related Knowledge	Course Supports
7.Environment and sustainable development : be able to discovery and analysis the impact of Surveying and mapping engineering practice on the sustainable development of environment and society	7.1 know and understand the concept and connotation of environmental protection and sustainable development	Xi Jinping's introduction to China's socialism thought in the new era, introduction to surveying and mapping geographic information, outline of Earth Science, natural geography and remote sensing interpretation practice.
	7.2 be able to recognize the sustainability of remote sensing engineering practice activities from the perspective of environmental protection and sustainable development, as well as analyze the possible damages and hidden dangers to the environment and society caused by the production practice of remote sensing engineering	Introduction to geoscience, practice of natural geography, geomorphology and remote sensing interpretation, graduation project, etc.
8. Occupational norms: have the quality of Humanities and Social Sciences and a sense of social responsibility, be able to understand and abide by the professional ethics and norms of Surveying and mapping and geographic information industry in the practice of remote sensing engineering, and fulfill their responsibilities.	8.1 have the quality of Humanities and Social Sciences, establish correct world outlook, outlook on life and values,	Ideological and moral cultivation and legal basis, Xi Jinping's new China's principle of socialism, general principles of Marx doctrine, sports (1-4), Labor Education(1-2) etc.
	8.2 understand the professional ethics and norms of the remote sensing industry in terms of honesty, justice and integrity, and consciously abide by the ideological and moral cultivation and legal basis	College Students' career and development planning, situation and policy (1-2) remote sensing comprehensive practice, etc.
	8.3 understand the social responsibility of remote sensing workers for the safety, health, well-being and environmental protection of the public, and be able to	College Students' mental health, digital topographic survey, physical geography and geomorphology, remote sensing image interpretation practice, etc.

Graduate Abilities	Related Knowledge	Course Supports
	consciously perform their responsibilities in the practice of remote sensing engineering	
9.Individuals and teams: be able to assume the roles of individual, team member and responsible person in a multi-disciplinary team.	9.1 be able to effectively communicate with members of Surveying and mapping, geographic information, computer and other disciplines, and work together with them	Engineering drawing and map recognition, introduction to geoscience, computer vision, object-oriented programming, practice of natural geography and geomorphology and remote sensing image interpretation, etc.
	9.2 be able to work independently or cooperatively in the team	Close range photogrammetry, digital topographic survey practice, new technology practice, etc.
	9.3 be able to organize, coordinate and command the team to carry out the work	Military training, object-oriented programming, comprehensive practice of spatial information, college surveying and mapping skills competition, etc.
10. Communication: be able to effectively communicate and exchange with the bank and the public on complex remote sensing engineering issues, including writing reports and design papers, making statements, clearly expressing or responding to instructions, and have a certain international vision, and be able to communicate and exchange in a cross-cultural context	10.1 be able to effectively communicate and exchange with peers and the public on complex remote sensing engineering issues during the writing of design books, technical reports and presentations	Urban remote sensing (Bilingual), scientific paper writing (Bilingual), comprehensive practice of spatial information, comprehensive practice of remote sensing, etc.
	10.2 have a certain international vision and understand the international cutting-edge development trend and research hotspot in the field of remote sensing	College English (1-2), introduction to surveying and mapping geographic information, principles of geographic information system (Bilingual), comprehensive practice of remote sensing, etc.
	10.3 have the ability of cross-cultural communication in language and written expression, be able to communicate and exchange on	College English (1-2), scientific paper writing (Bilingual), urban remote sensing (Bilingual), graduation project, etc.

Graduate Abilities	Related Knowledge	Course Supports
	remote sensing issues in cross-cultural context	
11. Project management: understand and master engineering management principles and economic decision-making methods, and be able to apply them in a multidisciplinary environment.	11.1 master the management and economic decision-making methods involved in engineering projects	Digital topographic survey practice, surveying and mapping management and laws and regulations, (close range and lidar, mobile measurement, microwave remote sensing) new technology practice, etc.
	11.2 understand the cost composition of remote sensing and mapping production, and understand the engineering management and economic decision-making issues involved in it	Modern surveying and mapping technology application, surveying and mapping management and laws and regulations, aerospace data acquisition, remote sensing comprehensive practice, graduation project, etc.
	11.3 be able to use engineering management and economic decision-making methods in the process of designing and developing remote sensing engineering solutions in a multidisciplinary environment.	Remote sensing technology application, modern surveying and mapping technology application, (close range and lidar, mobile measurement, microwave remote sensing) new technology practice, surveying and mapping management, laws and regulations, etc.
12. Lifelong learning: Have the awareness of autonomous learning and lifelong learning and the ability to learn, and adapt to the development.	12.1 The consciousness of autonomous learning and lifelong learning.	College Students' career and development planning, introduction to computer thinking, scientific and technological revolution and social development, digital topographic survey, remote sensing application prospect, etc.
	12.2 Have the ability of eternal learning and adapting development.	College English (1-2), introduction to surveying and mapping geographic information, in-depth learning and intelligent interpretation of remote sensing images, graduation design, innovative practice of Remote Sensing Science and technology, scientific research training, etc.

表 1　遥感科学与技术专业指导性教学计划

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续学时	开课学期	教学单位
通识教育课	必修	思想道德与法治 Ideological Morality and Rule of Law	3	48	48					1	马克思主义学院
		中国近现代史纲要 The Outline of the Modern Chinese History	3	48	32			16		2	马克思主义学院
		习近平新时代中国特色社会主义思想概论 Introduction to Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era	3	48	48					2	马克思主义学院
		习近平新时代中国特色社会主义思想在京华大地的生动实践 The Vivid Practice of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era in Beijing	0.5	8	8					2	马克思主义学院
		马克思主义基本原理★ Basic Principle of Marxism	3	48	48					3	马克思主义学院
		毛泽东思想和中国特色社会主义理论体系概论★ Introduction to Mao Zedong Thoughts and Theoretical System of Socialism with Chinese Characteristics	3	48	48					4	马克思主义学院
		形势与政策（1-4） Situation and Policy(1-4)	2	32	32					1-4	马克思主义学院
		大学生职业生涯与发展规划 College Student Occupation Career and Development Planning	1	16	16					1	学工部
		大学生心理健康 The Mental Health of College Students	1	16	16					2	学工部
		大学英语(1-2) ★ College English(1-2)	6	128	96				32	1-2	人文学院
		大学英语拓展系列课程（1-4） College English Training（1-4）	2	32	32					3	人文学院
		大学英语拓展系列课程（5-8） College English Training（5-8）	2	32	32					4	人文学院
		体育(1-4) Physical Education(1-4)	4	120	120					1-4	体育部
		计算思维导论 Introduction to Computational Thinking	1.5	56	24			32		1	电信学院
		“四史”（党史、新中国史、改革开放史、社会主义发展史） History of the Communist Party of China, History of New China, History of Reform and Opening up and History of Socialist Development	0.5	8	8					1-7	马克思主义学院
		小 计	35.5	688	608			48	32		
	核心	特色课程与人文素养	2	32						1-8	各院部
		经典研读与文化传承	2	32						1-8	各院部
		科技文明与城市发展	2	32						1-8	各院部
		建筑艺术与审美教育	2	32						1-8	各院部
		修读 4 类合计 8 学分，每类至少修读 2 学分									
	任选	工程实践类	1-8 学期任选								各院部
		复合培养类	1-8 学期任选								各院部
		任选至少修读 2 学分									
	通识教育课合计至少修读 45.5 学分。 其中通识教育必修 35.5 学分（含“四史”（党史、新中国史、改革开放史、社会主义发展史），四选一，1-7 学期内任意学期完成，0.5 学分），通识教育核心 8 学分，通识教育任选 2 学分（含体育类课程 1 学分）。										

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
大类基础课	必修	高等数学A（1）★ Advanced Mathematics A(1)	5	92	80				12	1	理学院
		高等数学A（2）★ Advanced Mathematics A(2)	5	84	80				4	2	理学院
		线性代数 Linear Algebra	2	40	32				8	2	理学院
		概率论与数理统计B Theory of Probability and Statistics (B)	3	48	44				4	3	理学院
		普通物理A（1）★ College physics A(1)	3	56	52			4		2	理学院
		普通物理A（2）★ College physics A(2)	3	56	52			4		3	理学院
		物理实验（1-2） Physics Experiment(1-2)	2	60		60				3-4	理学院
		C语言程序设计 C Programming Language	2	32	24	8				1	地理信息科学系
		地球科学概论 Introduction to Earth Science	2	32	32					1	地理信息科学系
		测绘地理信息概论 Introduction to Geomatics	1	16	16					1	测绘学院
		CAD基础与应用 CAD Basic and Application	2	32	16	16				1	测绘工程系
		数字地形测量学★ Digital Topographic Surveying	4	64	52	12				2	测绘工程系
		地图学 Cartography	3	48	40	8				3	地理信息科学系
		地理信息系统原理(双语) The Principle of Geographic Information System	3	48	40	8				3	地理信息科学系
		遥感原理与应用★ Principles of Remote Sensing	3	48	48					3	遥感科学与技术系
		小 计	43	756	608	112		8	28		
	选修	现代测绘技术应用 Application of Modern Surveying and Mapping Technology	1	16	16					2	测绘工程系
		GIS基础应用技能 GIS base Application Skill	1	16	8	8				2	地理信息科学系
		遥感应用前景 Remote Sensing Application Prospect	1	16	16					3	遥感科学与技术系
		小 计	3	48	40	8					
	大类基础课合计 44 学分，必修 43 学分，选修 1 学分										
专业核心课	必修	航空航天数据获取 Aerospace data acquisition	2	32	28	4				4	遥感科学与技术系
		城市遥感（双语） Urban Remote Sensing	3	48	40	8				6	遥感科学与技术系
		摄影测量学 Photogrammetry	3	48	44	4				5	遥感科学与技术系
		遥感数字图像处理 Digital Image Processing	3	48	40	8				5	遥感科学与技术系
		计算机视觉 Computer vision	3	48	40	8				6	遥感科学与技术系
		小计	14	224	192	32					
	专业核心课合计必修 14 学分										

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
专业方向课	必修	面向对象程序设计 object oriented programming	2	32	32					4	遥感科学与技术系
		误差理论与测量平差基础 Fundamentals of Error Theory and Surveying Adjustment	3	48	48					4	测绘工程系
		测绘管理与法律法规 Surveying Management and Laws	1	16	16					6	测绘工程系
		小　计	6	96	96	0					
	选修	遥感技术应用(研讨式教学)（限选） Applications of Remote Sensing in different fields（seminar）	2	32	16	16				6	遥感科学与技术系
		激光雷达测量技术与应用（限选）Laser radar Surveying Technology	2	32	24	8				6	遥感科学与技术系
		GNSS 原理及其应用（限选）GNSS principle and application	2	32	28	4				5	测绘工程系
		近景摄影测量（限选）Close Range Photogrammetry	2	32	26	6				6	遥感科学与技术系
		微波遥感（限选）Microwave Remote Sensing	2	32	32					5	遥感科学与技术系
		大地测量学基础 Geodesy Fundamental	2	32	24	8				4	测绘工程系
		遥感图像解译(限选） Remote sensing image interpretation	1.5	24	24					6	遥感科学与技术系
		新型航空遥感数据处理技术（限选）Modern aerial remote sensing data processing technology	2	32	32					7	遥感科学与技术系
		工程制图与识图（限选） Engineering Drawing and Interpreting	3	48	48					6	理学院
		空间数据库 Spatial Database	2	32	32					5	地理信息科学系
		数据结构（限选） Data structure	2	32	32					4	地理信息科学系
		移动道路测量技术及应用 Technology and Application of Mobile Mapping System	1	16	8	8				7	地理信息科学系
		计算机图形学（限选）Computer Graphics	2	32	32					5	地理信息科学系
		高光谱遥感 Hyperspectral remote sensing	2	32	24	8				6	遥感科学与技术系
		科技文献检索 document retrieval of science and technology	1	16	16			8		5	图书馆
		遥感影像深度学习与智能解译 Deep learning and intelligent interpretation of remote sensing image	2	32	32					7	遥感科学与技术系
		智慧城市导论 Introduction to smart city	1	16	16					6	地理信息科学系
		遥感软件 Remote Sensing Software	2	32	16	16				4	遥感科学与技术系
		GIS 软件使用 GIS Software	2	32	16	16				4	地理信息科学系
		可视化语言 IDL The Language IDL	2	32	16	16				5	遥感科学与技术系
		Python 程序设计　Python Programming	2	32	16	16				6	遥感科学与技术系
		自然资源管理 Geographic Conditions Monitoring	1.5	24	16	8				7	地理信息科学系
		大数据与地理信息系统 Big data and GIS	1.5	24	16	8				6	地理信息科学系
		小　计	42.5	680	542	138		8			
	专业方向课合计 27 学分，必修 6 学分，选修 21 学分										

表 2　遥感科学与技术专业指导性教学计划（实践环节）

课程属性	课程名称		学分	折合学时	实验实践	上机	开课学期	开设周次	教学单位
课内	军事理论 Military Theory		2	36			1	1-3	武装部
	军训 Military Training		2	112					
	形势与政策（5-8） Situation and Policy(5-8)		-	32			5-8	分散	马克思主义学院、各学院
	劳动教育（1-2） Labor Education(1-2)		1	32			3、7	分散	学工部、各院部
	数字地形测量实习 Digital Topographic Surveying Practice		3	60	60		2	18-20	测绘工程系
	地图学实习 Cartography Practice		2	40	40		3	17-18	地理信息科学系
	摄影测量学实习 Photogrammetry Fundamental Practice		1	20	20		5	18	遥感科学与技术系
	地理信息系统原理实习 The Principle of Geographic Information System Practice		2	40	40		3	19-20	地理信息科学系
	遥感数字图像处理实习 Digital Image Processing Practice		2	40	40		5	19-20	遥感科学与技术系
	计算机视觉实习 Computer vision practice		1	20	20		6	17	遥感科学与技术系
	空间信息综合实习 Spatial Information Practice		5	100	100		7	1-5	测绘学院
	遥感综合实习 Remote Sensing Comprehensive Practice		3	60	60		7	18-20	遥感科学与技术系
	遥感原理与应用实习 Principles and Applications of Remote Sensing Practice		1	20	20		4	18	遥感科学与技术系
	自然地理地貌及遥感图像解译实习 Natural geography and remote sensing image interpretation Practice		1	20	20		6	16	遥感科学与技术系
	（近景与激光雷达、移动测量、微波遥感）新技术实习 New technology Practice		2	40	40		7	16-17	遥感科学与技术系
	面向对象程序设计实习 Object oriented programming Practice		2	40	40		4	19-20	遥感科学与技术系
	毕业设计 Undergraduate Design or Thesis		8	160	160		8	1-16	遥感科学与技术系
	小　计		38	872	660				
课外	创新实践及科研训练	遥感科学与技术创新实践及科研训练	2	40	40				遥感科学与技术系
		全国论文大赛 National Paper Contest	1	20	20				遥感科学与技术系
		GIS 软件开发大赛实训 GIS Software Development Practice	1	20	20				地理信息科学系
		学院测绘技能大赛 School of Surveying and Mapping Skills Contest	1	20	20				测绘工程系
		测绘技能大赛实训	2	40	40				测绘工程系
		科技论文写作（双语）	1	16	0		6		遥感科学与技术系
	小　计		8	156	140				
实践环节合计 40 学分，其中课内 38 学分，课外 2 学分（创新实践及科研训练必修 2 学分）									

2022 级地理信息科学（第二学位）专业本科培养方案

一、专业基本信息

英文名称	Geographical Information Science		
专业代码	070504	学科门类	理学
学　　制	二年	授予学位	理学学士

二、培养目标及特色

培养目标：

培养具有德、智、体全面发展，具备数理基础和人文社科知识，掌握地理信息基础理论、基本知识和基本技能，接受科学思维和工程实践训练，胜任城市规划、地理国情、资源管理、环境保护等领域地理信息系统的设计、生产、研发及管理工作，具有较强的组织管理能力、创新能力、继续学习能力和国际视野的理工兼备的复合型人才。

专业特色：

本专业依托首都建设和学校土木建筑类学科优势，培养服务首都、面向全国的城市信息化建设的专业地理信息人才。适应地理信息高新科技发展，融教学、科研和生产为一体，强调理论与实践密切结合，突出城市空间信息特色，培养地理信息系统新技术、新方法的应用及软件设计开发的综合能力，满足城市空间信息化建设的地理信息系统人才需求。

三、主干学科

测绘科学技术、地理学、计算机应用。

四、主要课程(14 门)

空间数据库、空间分析与建模、地理信息系统设计与开发、WebGIS 技术与开发、城市空间信息学、误差理论与测量平差基础、卫星导航定位技术、摄影测量基础、Java 程序设计、人文地理学、GIS 应用（双语）、三维地理信息技术、遥感技术应用、计算机图形学

五、主要实践教学环节（7 门）

地理信息系统设计与开发实习，摄影测量基础实习，空间分析与建模实习，WebGIS 技术与开发实习 ，自然地理地貌及遥感图像解译实习 ，空间信息综合实习，毕业设计或论文

六、毕业学分要求

参照北京建筑大学本科学生学业修读管理规定及学士学位授予细则，修满本专业最低计划学分应达到 67.5 学分，其中理论课程 46.5 学分，独立实践教学环节 21 学分。

七、各类课程结构比例

课程类别	课程属性	学分	学时	学分比例
专业核心课	必修	16	256	23.70%
专业方向课	必修	20.5	352	30.37%
	选修	10	160	14.82%
独立实践环节	必修	21	420	31.11%
总计		67.5	1188	100%

八、教学进程表

学期	教学周	考试	实践	学期	教学周	考试	实践
1	1-15 周	16 周	17-20 周	2	1-16 周	17 周	18-20 周
3	7-19 周	20 周	1-6 周	4	1-16 毕业设计/实习 17 周答辩		

2022 Undergraduate Program for Specialty in Geographical Information Science （Second Bachelor Degree）

I Specialty Name and Code

English Name	**Geographical Information Science**		
Code	070504	Disciplines	Science
Length of Schooling	2 years	Degree	Bachelor of Science

II Educational Objectives and Features

Objectives: This program is to cultivate inter-disciplinary engineering talents, fully developed in morality, intelligence and physique, well equipped with mathematical science and social science, and highly skilled in basic theory, knowledge and profession of geographical information system. The students are required to have the systematic training of scientific thinking and engineering practice, so that they are competent in design, production, R&D and management of geographical information system, including urban planning, geographical conditions and environmental protection. Besides, the graduates have a good ability of organizing, innovation, learning, and international vision as well.

Features: This program features integrating the teaching, research and production together with the development of high-technology, stressing the combination of theory and practice, highlighting the urban spatial information characteristics, and pinpointing the comprehensive ability of application of new GIS technologies and software development. Based on the construction of Beijing and with the advantages of the civil construction disciplines of the University, this program aims to cultivate professional GIS talents for the urban informatization construction of Beijing and the whole country.

III Major Disciplines

Surveying Science and Technology, Geography, Computer Application

IV Major Courses

Spatial Database, Spatial Analysis and Modeling, Programming and Development for GIS, WebGIS Technology and Development, Urban Spatial Information Science, Fundamentals of Error Theory and Surveying Adjustment，Technology of Satellite navigation and positioning，Photogrammetry Fundamental，Java Programming，Human Geography，GIS Applications (Bilingual Education)，Technology of 3D GIS，Applications of Remote Sensing Technology，Computer Graphics.

V Major Practical Training（7 courses）

Programming and Development of GIS Practice, Photogrammetry Fundamental Practice, Spatial Analysis and Modeling Practice, WebGIS Technology and Development Practice, Natural Geography and Remote Sensing Practice, Comprehensive Practice of spatial information, Graduation Project or Thesis

VI Graduation Requirements

In accordance with "Management Regulations for the Undergraduate Students of Beijing University of Civil Engineering and Architecture" and "Bachelor's Degree Awarding Regulations", the minimum credits required by specialty for graduate is 67.5, including 46.5 credits of theoretical courses and 21 credits of practice teaching.

VII Proportion of Course

Course Category	Course Type	Credits	Class Hour	Proportion
Professional Core	Compulsory	16	256	23.70%
Professional Direction	Compulsory	20.5	352	30.37%
	Optional	10	160	14.82%
Practice	Compulsory	21	420	31.11%
Total		67.5	1188	100%

VIII Table of Teaching Program

Semester	Teaching	Exam	Practice	Semester	Teaching	Exam	Practice
1	1-15	16	17-20	2	1-16	17	18-20
3	7-19	20	1-6	4	1-16 Undergraduate Design or Thesis 17 Graduation reply		

表 1　地理信息科学（第二学位）专业指导性教学计划（1）

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
专业核心课	必修	空间数据库 Spatial Database	3	48	32	16				1	地理信息科学系
		空间分析与建模 Spatial Analysis and Modeling	2	32	24	8				1	地理信息科学系
		地理信息系统设计与开发 Programming and Development of GIS	3	48	24	24				1	地理信息科学系
		WebGIS 技术与开发 WebGIS Technology and Development	3	48	32	16				2	地理信息科学系
		城市空间信息学 Urban Spatial Information Science	2	32	24	8				3	地理信息科学系
		误差理论与测量平差基础★ Fundamentals of Error Theory and Surveying Adjustment	3	48	48					1	测绘工程系
		小计	16	256	184	72					
		专业核心课合计必修 16 学分。									
专业方向课	必修	卫星导航定位技术 Technology of Satellite navigation and positioning	2	32	28	4				1	测绘工程系
		摄影测量基础 Photogrammetry Fundamental	3	48	44	4				1	遥感工程系
		Java 程序设计 Java Programming	2	32	24	8				1	地理信息科学系
		人文地理学 Human Geography	1.5	32	16	16				1	地理信息科学系
		计算机图形学 Computer Graphics	2	32	24	8				1	地理信息科学系
		科技论文写作（双语）Academic Writing (Bilingual Education)	1	16	16					2	遥感工程系
		科技文献检索 Document Retrieval of Science and Technology	1	24	16			8		3	图书馆
		城市规划与建设地理信息系统 Geographic Information System for City Planning and Construction	2.5	48	24	24				2	地理信息科学系
		GIS 应用（双语）GIS Applications (Bilingual Education)	1.5	24	16	8				2	地理信息科学系
		三维地理信息技术 Technology of 3D GIS	2	32	16	16				2	地理信息科学系
		遥感技术应用 Applications of Remote Sensing Technology	2	32	16	16				2	遥感工程系
		小计	20.5	352	240	104		8			
		专业方向课合计必修 20.5 学分。									

表 2 地理信息科学（第二学位）专业指导性教学计划（2）

课程类别	课程属性	课程名称	学分	总学时	讲课学时	实验学时	上机学时	课外学时	延续教学	开课学期	教学单位
专业方向课	选修	移动 GIS 开发 Mobile GIS Development	2	32	16	16				3	地理信息科学系
		数字地面模型 Digital Terrain Model	2	32	16	16				3	地理信息科学系
		移动道路测量技术及应用 Technology and Application of Mobile Mapping System	1	16	8	8				3	地理信息科学系
		激光雷达测量技术与应用 Laser Radar Surveyging Technology and Application	2	32	24	8				2	测绘工程系
		测绘地理信息技术前沿 Advanced Technology of Surveying,Maping and GIS	1	16	16					3	测绘学院
		智慧城市导论 Introduction to Smart City	1	16	16					2	地理信息科学系
		近景摄影测量 Close Range Photogrammetry	2	32	26	6				2	遥感工程系
		城市遥感(双语)Urban Remote Sensing(Bilingual Education)	2.0	32	24	8				2	遥感工程系
		城市规划概论 Conspectus of Urban Planning	1.5	24	20	4				3	建筑学院
		遥感图像处理 Remote Sensing Image Processing	2	32	24	8				1	遥感工程系
		BIM 技术与应用 BIM Technology and Application	2	32	16	16				3	经管学院
		市场营销 Marketing Management	1.5	24	24					3	经管学院
		小　计	20	320	230	90					
	专业方向课选修合计 20 学分，至少选修课 10 学分。										

表 3　地理信息科学（第二学位）专业指导性教学计划（实践环节）

课程属性	课程名称	学分	折合学时	实验实践	上机	开课学期	开设周次	教学单位
课内	地理信息系统设计与开发实习 Programming and Development of GIS Practice	2	40			1	19-20	地理信息科学系
	摄影测量基础实习 Photogrammetry Fundamental Practice	1	20			1	18	遥感工程系
	空间分析与建模实习 Spatial Analysis and Modeling Practice	1	20			1	17	地理信息科学系
	WebGIS 技术与开发实习 WebGIS Technology and Development Practice	2	40			2	18-19	地理信息科学系
	自然地理地貌及遥感图像解译实习 Natural Geography and Remote Sensing image interpretation Practice	1	20			2	20	遥感工程系
	空间信息综合实习 Comprehensive Practice	6	120	120		3	1-6	测绘学院
	毕业设计或论文 Undergraduate Design or Thesis	8	160	160		4	1-16	地理信息科学系
	合　计	21	420					
实践环节合计 21 学分，课内必修 21 学分。								