目　录

2020 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 170 学分，其中理论课程 131 学分，实践教学环节 39 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	41.5	688	24.41%
	选修	2	32	1.18%
大类基础课	必修	43	756	25.29%
	选修	1	16	0.59%
专业核心课	必修	16	256	9.41%
专业方向课	必修	6	96	3.53%
	选修	21.5	344	12.65%
独立实践环节	必修	37	840	21.76%
	选修	2	40	1.18%
总计		170	3068	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	计算思维导论、C 语言程序设计、数据结构、CAD 基础与应用、工程制图与识图、高等数学 A(1-2)、概率与数理统计 B、普通物理 A(1-2)、线性代数、土木工程概论、地图学、遥感原理与应用、地球科学概论、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	高等数学 A(1-2)、线性代数、物理实验（1-2)、数字地形测量学、地理信息系统原理（双语)、摄影测量学、变形监测与灾害预报、大地测量学基础、误差理论与测量平差基础等。
	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、CAD 基础与应用、工程制图与识图、线性代数、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。
	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	C 语言程序设计、数据结构、概率与数理统计 B、数字地形测量实习、地图学实习、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	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、C 语言程序设计、数据结构、高等数学 A(1-2)、概率与数理统计 B、物理实验（1-2)、线性代数、土木工程概论、C#程序设计、地图学、地理信息系统原理

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）
论。		（双语）、地球科学概论、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	CAD 基础与应用、数字地形测量学、误差理论与测量平差基础、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	C 语言程序设计、数据结构、科技文献检索、摄影测量学、大地测量学基础、地理信息系统原理实习、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	普通物理 A(1-2)、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	计算思维导论、GIS 基础应用技能、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、CAD 基础与应用、地理信息系统原理（双语）、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	数字地形测量学、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。

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）
	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	测绘地理信息概论、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。
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	地图学、地理信息系统原理（双语）、大地测量学基础、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	计算思维导论、工程制图与识图、遥感原理与应用、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、地图学、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	计算思维导论、C 语言程序设计、CAD 基础与应用、C#程序设计、数字地形测量学、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	工程制图与识图、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、

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）
	行技术设计、数据处理与精度分析	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	概率与数理统计 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、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	思想道德修养与法律基础、土木工程概论、数字地形测量学、遥感原理与应用、大地测量学基础、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概论、毛泽东思想和中国特色社会主义体系理论概论、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	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、地理国情监测、自然资源管理、形势与政策（1-4）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	市场营销、地球科学概论、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、

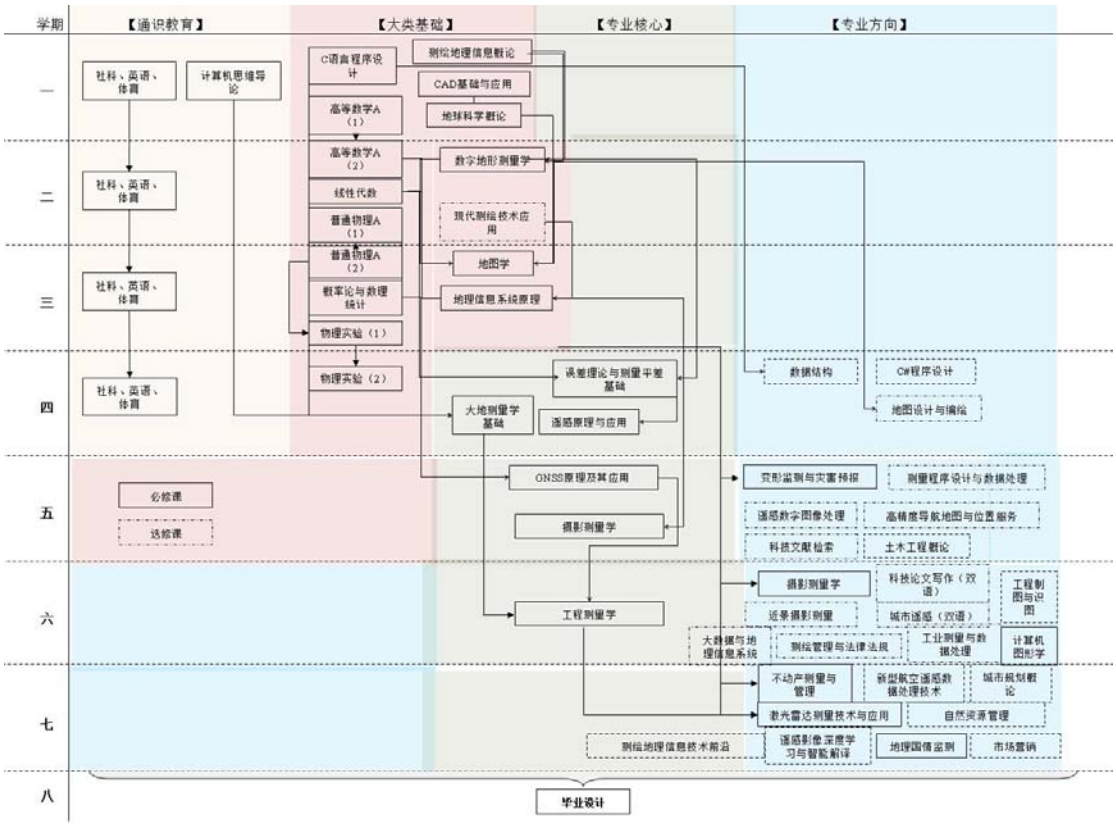
毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
	持续性，评价测绘工程实践中可能对人类和环境造成的损害和隐患	控制测量实习、不动产测量与管理实习、复合培养类、毕业设计等。
8.职业规范：具有人文社会科学素养、社会责任感，能够在测绘工程实践中理解并遵守测绘行业职业道德和规范，履行责任。	8.1 具有正确价值观，理解个人与社会的关系，了解中国国情	思想道德修养与法律基础、中国近现代史纲要、马克思主义基本原理概论、毛泽东思想和中国特色社会主义体系理论概论、体育（1-4）等。
	8.2 理解诚实公正、诚信守则的测绘行业职业道德和规范，并能在测绘工程实践中自觉遵守	思想道德修养与法律基础、中国近现代史纲要、毛泽东思想和中国特色社会主义体系理论概论、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、形势与政策（1-4）、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	马克思主义基本原理概论、大学生职业生涯与发展规划、形势与政策（5-8）、测绘地理信息概论、地球科学概论、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	大学生职业生涯与发展规划、体育（1-4）、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。

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）
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	大学英语（1-2）、英语国家文化、地理信息系统原理（双语）、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	大学英语（1-2）、科技论文写作（双语）、口语、英语报刊选读、专门用途英语、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、数字地形测量实习、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	思想道德修养与法律基础、大学生职业生涯与发展规划、专门用途英语、英美文学名篇赏析、测绘地理信息概论、误差理论与测量平差基

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）
		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概论、毛泽东思想和中国特色社会主义体系理论概论、地球科学概论、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

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 170, including131credits of theoretical courses and 39 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	41.5	688	24.41%
	Optional	2	32	1.18%
Big Academic Subjects	Compulsory	43	756	25.29%
	Optional	1	16	0.59%
Professional Core	Compulsory	16	256	9.41%
Professional Direction	Compulsory	6	96	3.53%
	Optional	21.5	344	12.65%
Practice	Compulsory	37	840	21.76%
	Optional	2	40	1.18%
Total		170	3068	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	Introduction to Computational Thinking、C Language Programming Design、Data Structure、CAD Basic and Application、Engineering Drawing and Interpreting、Advanced Mathematics A(1-2)、Theory of Probability and Statistics (B)、College physics A(1-2)、Linear Algebra、Introduction to Civil Engineering、Cartography、Application and Principles of Remote Sensing、Introduction to Earth Science、Computer Graphics、Remote Sensing Digital Image Processing.

Graduate Abilities	Related Knowledge	Course Supports
	1.2 Be able to establish mathematical model and solve for specific surveying and mapping objects	Advanced Mathematics A(1-2)、Linear Algebra、Physics Experiment(1-2)、Digital Topographic Surveying、Principle of Geographic Information System、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	Introduction to Computational Thinking、CAD Basic and Application、Engineering Drawing and Interpreting、Linear Algebra、Application and Principles of GNSS、Application and Technology of Laser Radar Surveying、Computer Graphics、Engineering Surveying、emote Sensing Digital Image Processing.
	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	C Programming Language Design、Data Structure、Theory of Probability and Statistics (B)、Digital Topographic Surveying Practice、Cartography Practice、Photogrammetry Practical、Comprehensive Practice for Spatial Information、Graduation design.

Graduate Abilities	Related Knowledge	Course Supports
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、C Programming Language Design、Data Structure、Advanced Mathematics A(1-2)、Theory of Probability and Statistics (B)、Physics Experiment(1-2)、Linear Algebra、Introduction to Civil Engineering、C# Programming、Cartography、Principle of Geographic Information System、Introduction to Earth 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	CAD Basic and Application、Digital Topographic Surveying、Fundamentals of Error Theory and Surveying Adjustment、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	C Programming Language Design、Data Structure、Photogrammetry、Foundation of Geodesy、Engineering Surveying、GIS Practice、Practical Training for Real Estate Surveying and Management.
	2.4 Can use the basic principles of mathematics, natural	College physics A(1-2)、Document Retrieval of Science and Technology、Application and Principles of GNSS、Practical Training for

Graduate Abilities	Related Knowledge	Course Supports
	science and Engineering Science, with the aid of literature research, analyze the influencing factors of the process, and obtain effective conclusions	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 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.	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 technical solutions	Introduction to Computational Thinking、CAD Basic and Application、GIS base Application Skill、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..
	3.2 Be able to complete the design of Surveying and mapping system and production process according to specific requirements	Surveying Program Design and Data Processing、CAD Basic and Application、Principle of Geographic Information System、Photogrammetry Practice、Application and Principles of GNSS、Application and Technology of Laser Radar Surveying、Engineering Surveying、Comprehensive Practice for Spatial Information、Surveying

Graduate Abilities	Related Knowledge	Course Supports
		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	Digital Topographic Surveying、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	Introduction to Geomatics、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 through information synthesis.	4.1 Based on scientific principles, through literature research, using scientific methods, research and analyze the solutions of complex surveying and mapping engineering problems	Cartography、Principle of Geographic Information System、Foundation of Geodesy、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	Introduction to Computational Thinking、Engineering Drawing and Interpreting、Application and Principles of Remote Sensing、Photogrammetry、Application and Principles of GNSS、Practical Training for Engineering

Graduate Abilities	Related Knowledge	Course Supports
	be selected and the technical scheme of Surveying and mapping can be designed	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	5.1 Understand the principles and methods of modern surveying and mapping instruments, information technology tools and	Introduction to Computational Thinking、C Programming Language Design、CAD Basic and Application、C# Programming、Digital Topographic Surveying、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.

Graduate Abilities	Related Knowledge	Course Supports
instruments and information technology tools, including prediction and Simulation of complex surveying and mapping engineering problems, and understand their limitations.	mapping software commonly used in surveying and mapping, and understand their limitations	
	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	Engineering Drawing and Interpreting、Digital Topographic Surveying、Practical Training for Remote Sensing Principles、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 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	Theory of Probability and Statistics (B)、College physics A(1-2)、Linear Algebra、Document Retrieval of Science and Technology、Fundamentals of Error Theory and Surveying Adjustment、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).

Graduate Abilities	Related Knowledge	Course Supports
	and mapping engineering problems, and analyze their limitations	
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	Thought Morals Accomplishment and Basic Law、Introduction to Civil Engineering、Digital Topographic Surveying、Application and Principles of Remote Sensing、Foundation of Geodesy、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	The Outline of the Modern Chinese History、The Generality of Basic Principle of Marxism、Introduction to Mao Zedong Thoughts and Theoretical System of the Chinese characteristic socialism、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.

Graduate Abilities	Related Knowledge	Course Supports
	responsibilities that should be borne	
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	Physics Experiment(1-2)、Introduction to Geomatics、Introduction to Earth Science、Remote Sensing Digital Image Processing、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 evaluate the damage and hidden danger that may be caused to human and environment in the practice of Surveying and mapping engineering	Marketing Management、Introduction to Earth Science、Real Estate Surveying and Management、Introduction to Smart City、Geographic Conditions Monitoring、Deformation Monitoring and Disasters Predicting、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	8.1 Have correct values, understand the relationship between individuals and society, and understand China's	Thought Morals Accomplishment and Basic Law、The Outline of the Modern Chinese History、The Generality of Basic Principle of Marxism、Introduction to Mao Zedong Thoughts and Theoretical System of the Chinese characteristic socialism、Physical

Graduate Abilities	Related Knowledge	Course Supports
professional ethics and norms of Surveying and mapping industry in the practice of Surveying and mapping, and fulfill the responsibility.	national conditions	Education(1-4).
	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、Introduction to Mao Zedong Thoughts and Theoretical System of the Chinese characteristic socialism、College Student Occupation Career and Development Planning、Introduction to Geomatics、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、College Student Occupation Career and Development Planning、Situation and Policy(5-8)、Introduction to Geomatics、Introduction to Earth Science、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	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、Engineering Mechanics、Conspectus of Urban Planning、Surveying Program Design and Data Processing and、Graduation design.
	9.2 Ability to work	Invocation Practice(School of Surveying and

Graduate Abilities	Related Knowledge	Course Supports
disciplines.	independently or cooperatively in a team	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 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、Cartography Practice、GIS Practice、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	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	Cartography Practice、Practical Training for Control Surveying、Comparative Practical Training for Engineering Surveying、Graduation design.
	10.2 Understand the international	College English(1-2)、English Country Culture、Principle of Geographic Information

Graduate Abilities	Related Knowledge	Course Supports
vision, and being able to communicate and exchange in cross-cultural background.	development trends and research hotspots in the field of Surveying and mapping, and understand and respect the differences and diversity of different cultures	System、Comprehensive Practice for Spatial Information、Application of Modern Surveying and Mapping Technology、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	College English(1-2)、Scientific Paper writing、Oral English、Selected readings of English Newspapers、 English for Specific Purposes、Engineering Practice、Compound Training、Cross-cultural credit requirements for the second classroom (participation in international conferences, exhibitions and volunteers, 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,	11.1 Master the management and economic decision-making methods involved in the project	Introduction to Civil Engineering、Marketing Management、Real Estate 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	Marketing Management、Surveying Management and Laws、Practical Training for Spatial Information、Graduation design.

Graduate Abilities	Related Knowledge	Course Supports
architecture, civil engineering, environment and other disciplines.	engineering and production of Surveying and mapping products, and understand the engineering management and economic decision-making problems involved	
	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	Thought Morals Accomplishment and Basic Law、College Student Occupation Career and Development Planning、English for Specific Purposes、Appreciation of Famous British and American Literature、Introduction to Geomatics、Fundamentals of Error Theory and Surveying Adjustment、Surveying Management and Laws、Advanced Technology of Surveying.
	12.2 Have the ability of self-learning and	The Generality of Basic Principle of Marxism、Introduction to Mao Zedong Thoughts and

Graduate Abilities	Related Knowledge	Course Supports
	adapting to development, including the ability to understand the surveying and mapping technical problems, the ability to summarize and the ability to ask questions.	Theoretical System of the Chinese characteristic socialism、Introduction to Earth Science、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	延续教学	开课学期	教学单位
通识教育课	必修	思想道德修养与法律基础 Thought Morals Accomplishment and Basic 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
		马克思主义基本原理概论★ The Generality of 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体系理论概论★ Introduction to Mao Zedong Thoughts and Theoretical System of the Chinese characteristic socialism	5	80	64			16		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					1/2	学工部
		大学生心理健康 The Mental health of College Students	1	16	16					1/2	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		1/2	电信学院
		小 计	33.5	656	560			80	32		
	核心	建筑艺术与城市设计	2	32						1-8	各院部
		哲学逻辑与人文素养	2	32						1-8	各院部
		创新创业与社会发展	2	32						1-8	各院部
		生态文明与智慧科技	2	32						1-8	各院部
		至少修读 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
		跨类任选至少 2 学分									
	通识教育课合计至少修读 43.5 学分 ， 其中通识教育必修 33.5 学分，通识教育核心 8 学分，通识教育任选 2 学分（含体育课 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
		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	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	32					4	遥感工程系
		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	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
		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 27.5 学分，必修 6 学分，任选至少修读 21.5 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					
	形势与政策（5-8）Situation and Policy(5-8)		-	32			5-8	分散	马院、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
	遥感原理实习 Practical Training for Principles of Remote Sensing		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		37	840	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
		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

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
		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 39 学分，课内必修 37 学分，课外（创新实践及科研训练）必修 2 学分									

2020 级测绘工程(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	Surveying and Mapping Engineering（Intelligent Navigation）		
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，掌握测绘工程与导航定位基础理论、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、应急管理、智能交通、位置服务等领域项目的设计、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、国际视野和智能导航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）具备基础测绘、高精度导航地图生产、导航产品制造、大数据分析与位置服务、智能导航硬件研发等专业技术能力，能在国家基础测绘、城乡建设、应急管理、智能交通、位置服务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，成为测绘地理信息及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，具备解决智慧城市测绘相关问题，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，服务于城市测绘与管理、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、工程制图与识图、C 语言程序设计、地球科学概论、导航装备基础、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、嵌入式系统与程序设计、高精度导航地图与位置服务、GNSS 程序设计、室内定位与智能导航。

五、主要实践教学环节

1．主要实验

数字地形测量学实验 、GNSS 原理及其应用实验 、摄影测量学实验、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、导航装备基础实验。

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、导航装备基础实习、工程测量综合实习、导航定位综合实习、高精度地图采集实习、导航定位嵌入式研发实习。

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 174 学分，其中理论课程 131 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	41.5	672	23.85%
	选修	2	32	1.15%
大类基础课	必修	44.5	772	25.57%
专业核心课	必修	14	224	8.05%
专业方向课	必修	11	176	6.32%
	选修	18	288	10.34%
独立实践环节	必修	37	1224	21.26%
	选修	6	120	3.45%
总计		174	3508	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	1-15 周	16 周	17-20 周
3	1-14 周	15-16 周	17-20 周	4	1-15 周	16 周	17-20 周

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	6-18 周	19 周	1-5 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

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与导航问题的表述	计算思维导论、C 语言程序设计、GNSS 程序设计、CAD 基础与应用、工程制图与识图、高等数学 A(1-2)、概率与数理统计 B、普通物理 A(1-2)、线性代数、土木工程概论、地图学、遥感原理与应用、地球科学概论、计算机图形学、地图设计与编绘等。
	1.2 能针对具体的测绘与导航对象建立数学模型并求解	高等数学 A(1-2)、线性代数、物理实验（1-2)、数字地形测量学、地理信息系统原理（双语)、摄影测量学、变形监测与灾害预报、大地测量学基础、误差理论与测量平差基础、导航装备基础等。
	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、分析复杂测绘与导航问题	计算思维导论、CAD 基础与应用、工程制图与识图、线性代数、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、地图设计与编绘等。
	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与导航问题解决方案的比较与综合	C 语言程序设计、GNSS 程序设计、概率与数理统计 B、数字地形测量实习、地图学实习、摄影测量实习、导航装备基础实习、导航定位综合实习、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与导航问题的关键环节	计算思维导论、C 语言程序设计、GNSS 程序设计、高等数学 A(1-2)、概率与数理统计 B、物理实验（1-2)、线性代数、土木工程概论、C#程序设计、地图学、地理信息系统原理（双语)、地球科学概论、变形监测与灾害预报、摄影测量实习、地图设计与编

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）
		绘等。
	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与导航问题	CAD 基础与应用、数字地形测量学、误差理论与测量平差基础、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、室内定位与智能导航等。
	2.3 能认识到解决测绘与导航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	C 语言程序设计、GNSS 程序设计、科技文献检索、摄影测量学、大地测量学基础、工程测量学、地理信息系统原理实习、高精度地图采集实习等。
	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	普通物理 A(1-2)、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、科研团队创新训练等。
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 掌握测绘与导航工程设计、实施、管理等全流程相关技术，以及测绘与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。	计算思维导论、CAD 基础与应用、GIS 基础应用技能、不动产测量与管理、智慧城市导论、工程测量学、摄影测量实习、工程测量综合实习、导航定位综合实习、地图设计与编绘等。
	3.2 能够针对特定需求，完成测绘与导航系统、产品研发流程的设计	GNSS 程序设计、CAD 基础与应用、地理信息系统原理（双语）、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、卫星导航定位实习、测量程序设计大赛实训等。
	3.3 能够进行测绘与导航系统或产品研发流程的设计，在设计中体现创新意识	数字地形测量学、工程测量学、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 在测绘与导航系统或产品研发流程的设计中能够考虑安全、健康、	测绘地理信息概论、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、

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、文化及环境等制约因素	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与导航问题的解决方案	地图学、地理信息系统原理（双语）、大地测量学基础、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 能够根据测绘与导航对象特征，选择研究路线，设计测绘与导航技术方案	计算思维导论、工程制图与识图、遥感原理与应用、摄影测量学、GNSS 原理及其应用、导航定位综合实习等。
	4.3 能够根据测绘与导航技术方案构建实验系统，安全地开展测绘与导航实验，正确地采集测绘与导航实验数据	GNSS 程序设计、激光雷达测量技术与应用、卫星导航定位实习、测量程序设计大赛实训、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、地图学、科技论文写作（双语）、工程测量学、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、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与导航仪器、信息技术工具和测绘与导航软件的使用原理和方法，并理解其局限性	计算思维导论、C 语言程序设计、CAD 基础与应用、C#程序设计、GNSS 程序设计、数字地形测量学、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。
	5.2 能够选择与使用恰当的现代测绘与导航仪器、信息资源和测绘与导航软件，对复杂测绘与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、工业智能定位测量、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、毕业设计、测绘技能大赛实训等。
	5.3 能够针对具体的测	概率与数理统计 B、普通物理（1-2）、

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）
	绘与导航对象，开发或选用满足特定需求的现代测绘与导航仪器、信息技术工具，对复杂测绘与导航工程问题进行预测与模拟，并能够分析其局限性	线性代数、科技文献检索、误差理论与测量平差基础、测量程序设计与数据处理、摄影测量基础实习、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 了解测绘与导航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	思想道德修养与法律基础、土木工程概论、数字地形测量学、遥感原理与应用、大地测量学基础、GNSS 原理及其应用、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、工程测量综合实习、工程实践类、毕业设计等。
	6.2 能分析和评价测绘与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概论、毛泽东思想和中国特色社会主义体系理论概论、工程测量学、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	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、地理国情监测、自然资源管理、形势与政策（1-4）等。
	7.2 能够从环境保护和可持续发展的角度思考测绘与导航工程实践的可持续性，评价测绘与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、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	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	思想道德修养与法律基础、中国近现代史纲要、马克思主义基本原理概论、毛泽东思想和中国特色社会主义体系理论概论、体育（1-4）、军训、军事

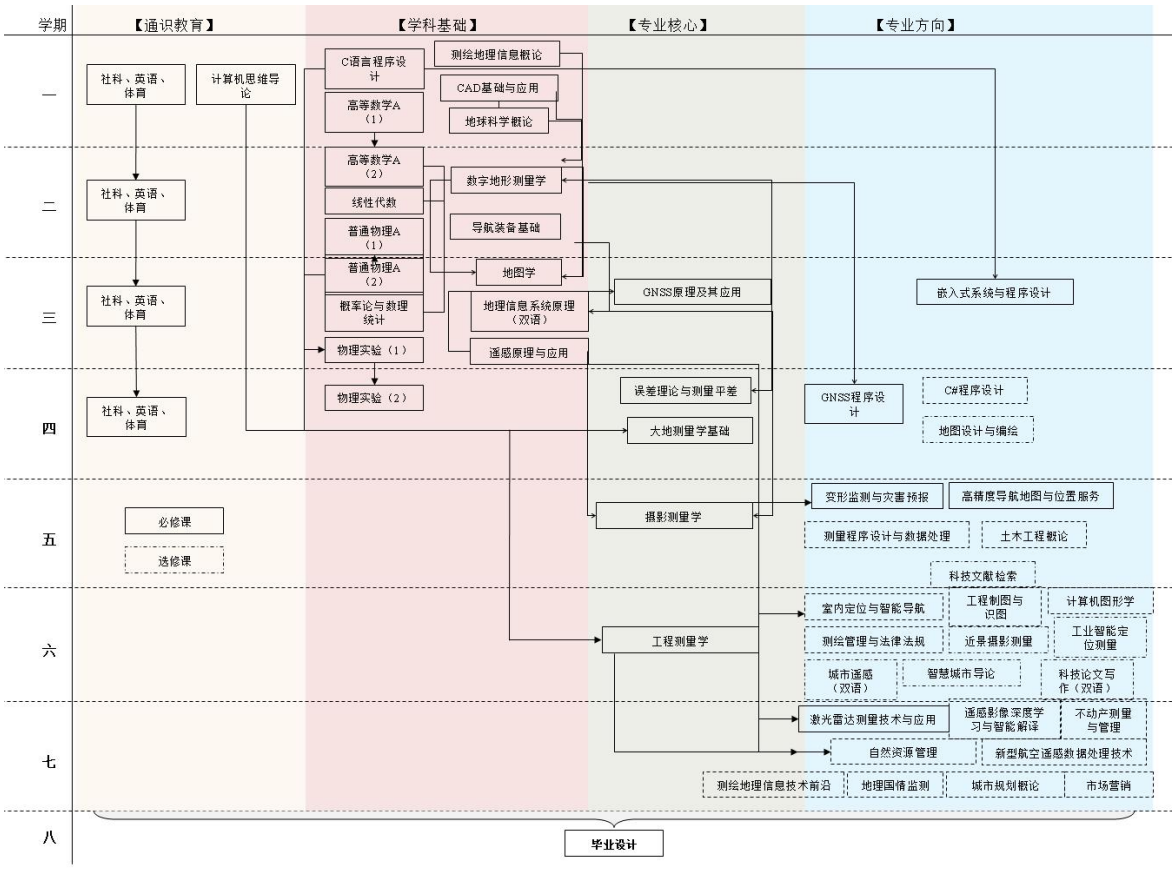
毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
和规范，履行责任。		理论等。
	8.2 理解诚实公正、诚信守则的测绘与导航行业职业道德和规范，并能在测绘与导航工程实践中自觉遵守	思想道德修养与法律基础、中国近现代史纲要、毛泽东思想和中国特色社会主义体系理论概论、大学生职业生涯与发展规划、测绘地理信息概论、测绘管理与法律法规、形势与政策（1-4)、数字地形测量实习、不动产测量与管理实习、导航定位综合实习等。
	8.3 理解测绘与导航工作人员对公众的安全、健康、福祉、环境保护的社会责任，能够在测绘与导航工程实践中自觉履行责任	马克思主义基本原理概论、大学生职业生涯与发展规划、形势与政策（5-8)、测绘地理信息概论、地球科学概论、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	大学生职业生涯与发展规划、体育（1-4)、土木工程概论、城市规划概论、测量程序设计与数据处理、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、卫星导航定位实习、控制测量实习、工程测量综合实习、激光雷达测量技术实习、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、地图学实习、地理信息系统原理实习、导航定位综合实习、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	10.1 能就测绘与导航专业问题，在测绘与导航技术设计书、测绘与导航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，理解与测绘与导航同行及社会公	地图学实习、控制测量实习、工程测量综合实习、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）
野，能够在跨文化背景下进行沟通和交流。	众交流的差异性	
	10.2 了解测绘与导航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	大学英语（1-2）、英语国家文化、地理信息系统原理（双语）、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，能就测绘与导航专业问题，在跨文化背景下进行基本沟通和交流	大学英语（1-2）、科技论文写作（双语）、口语、英语报刊选读、专门用途英语、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	土木工程概论、市场营销、不动产测量与管理、数字地形测量实习、控制测量实习、工程测量综合实习、毕业设计等。
	11.2 了解测绘与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	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，在设计开发测绘与导航方案的过程中，运用工程管理与经济决策方法	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	思想道德修养与法律基础、大学生职业生涯与发展规划、专门用途英语、英美文学名篇赏析、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，包括对测绘与导航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概论、毛泽东思想和中国特色社会主义体系理论概论、地球科学概论、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

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）
		实践（测绘技能大赛、测绘科技论文写作大赛、北斗创新创业大赛、导航定位终端嵌入式程序设计大赛、“北斗杯”全国青少年科技创新大赛）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 (Intelligent Navigation)

I Specialty Name and Code

English Name	**Surveying and Mapping Engineering（Intelligent Navigation）**		
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 and 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 national basic surveying and mapping, urban and rural construction, emergency management, intelligent transportation, location-based services and other fields And management, 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) It has the professional technical ability of basic surveying and mapping, high-precision navigation map production, navigation product manufacturing, big data analysis and location service, intelligent navigation hardware research and development, and is competent in surveying and mapping technology work in the fields of national basic surveying and mapping, urban and rural construction, emergency management, intelligent transportation, location service, etc;

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

(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 surveying and mapping talents who serve the capital and face the whole country, have the ability to solve the problems related to smart city surveying and mapping, and can carry out the research and development of navigation positioning products and integrated solution design. 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 serves urban surveying and mapping 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 Geomatics, Engineering Drawing and Read Drawing, C Language Programming Design, Introduction to Earth Science, Foundation of Navigation Equipment, Digital Topographic Surveying, Cartography, CAD Basic and Application, Fundamentals of Error Theory and Surveying Adjustment, Foundation of Geodesy, Principle of Geographic Information System (Bilingual), Application and Principles of Remote Sensing, Photogrammetry.

2. Specialty Courses

Application and Principles of GNSS, Engineering Surveying, Embedded System and Programming, High Precision Navigation Map and Location Service, GNSS Programming, Indoor Positioning and Intelligent Navigation.

V Major Practical Training

1. Major experiment

Experiment of Digital Topographic Surveying, Experiment of Application and Principle of GNSS, Experiment of Photogrammetry, Experiment of GIS Principle, Experiment of Foundation of Geodesy, Experiment of Engineering Surveying, Experiment of Foundation of Navigation Equipment.

2. Major Practical Training

Digital Topographic Surveying Practice, Satellite Navigation and Positioning Practice, Principle of Remote Sensing Practice, Photogrammetry Practice, GIS Practice, Cartography Practice, Control Surveying Practice, Foundation of Navigation Equipment Practice, Comprehensive Training for Engineering Surveying, Comprehensive Training for Navigation and Positioning, High-precision Map Collection Practice, Navigation and Positioning Embedded Research and Development 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 174, including 131 credits of theoretical courses and 43 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	41.5	672	23.85%
	Optional	2	32	1.15%
Big Academic Subjects	Compulsory	44.5	772	25.57%
Professional Core	Compulsory	14	224	8.05%
Professional Direction	Compulsory	11	176	6.32%
	Optional	18	288	10.34%
Practice	Compulsory	37	1224	21.26%
	Optional	6	120	3.45%
Total		174	3508	100%

VIII Table of Teaching Program

Semester	Teaching	Exam	Practice	Semester	Teaching	Exam	Practice
1	4-19	20	1-3	2	1-15	16	17-20
3	1-14	15-16	17-20	4	1-15	16	17-20
5	1-16	17-18	19-20	6	1-14	15	16-20
7	6-18	19	1-5 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 & Navigation problems	Introduction to Computational Thinking、C Language Programming、GNSS Programming、CAD Basic and Application、Engineering Drawing and Interpreting、Advanced Mathematics A(1-2)、Theory of Probability and Statistics (B)、College physics A (1-2)、Linear Algebra、Introduction to Civil Engineering、Cartography、Application and Principles of Remote Sensing、Introduction to Earth Science、Computer Graphics、Map Design and Compilation.

Graduate Abilities	Related Knowledge	Course Supports
	1.2 Be able to establish mathematical model and solve for specific Surveying and Mapping Engineering & Navigation objects	Advanced Mathematics A(1-2)、Linear Algebra、Physics Experiment(1-2)、Digital Topographic Surveying、Principle of Geographic Information System、Photogrammetry、Deformation Monitoring and Disasters Predicting、Foundation of Geodesy、Fundamentals of Error Theory and Surveying Adjustment、Foundation of Navigation Equipment.
	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 & Navigation problems	Introduction to Computational Thinking、CAD Basic and Application、Engineering Drawing and Interpreting、Linear Algebra、Application and Principles of GNSS、Application and Technology of Laser Radar Surveying、Computer Graphics、Engineering Surveying、Map Design and Compilation.
	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 & Navigation problems	C Language Programming、GNSS Programming、Theory of Probability and Statistics (B)、Digital Topographic Surveying Practice、Cartography Practice、Photogrammetry Practice、Foundation of Navigation Equipment Practice、Comprehensive Practice for Navigation and Positing、Graduation design.
2. Problem analysis: Be able to apply the basic principles of mathematics, natural science and engineering science to identify, e	2.1 Be able to identify and judge the key links of complex Surveying and Mapping Engineering &	Introduction to Computational Thinking、C Language Programming、GNSS Programming、Advanced Mathematics A(1-2)、Theory of Probability and Statistics (B)、Physics Experiment(1-2)、Linear Algebra、Introduction to Civil Engineering、C# Progra

Graduate Abilities	Related Knowledge	Course Supports
xpress and analyze complex surveying and mapping engineering problems through literature research, so as to obtain effective conclusions.	Navigation problems by using the principles of mathematics, natural science and engineering science	mming、Cartography、Principle of Geographic Information System、Introduction to Earth Science、Deformation Monitoring and Disasters Predicting、Photogrammetry Practice、Map Design and Compilation.
	2.2 Be able to correctly express complex Surveying and Mapping Engineering & Navigation problems based on the principles of mathematics, natural science and engineering science and mathematical model	CAD Basic and Application、Digital Topographic Surveying、Fundamentals of Error Theory and Surveying Adjustment、Surveying Program Design Practice Contest、Application and Technology of Laser Radar Surveying、GIS base Application Skill、Engineering Surveying、Indoor Positing and Intelligent Navigation.
	2.3 Can realize that there are many solutions to solve the problem of Surveying and Mapping Engineering & Navigation, and will seek alternative solutions through literature research	C Language Programming、GNSS Programming、Document Retrieval of Science and Technology、Photogrammetry、Foundation of Geodesy、Engineering Surveying、GIS Practice、Practical Training for High-precision Map Collection.
	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	College physics A(1-2)、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.

Graduate Abilities	Related Knowledge	Course Supports
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 design process, and consider factors such as society, health, safety, law, culture and environment.	3.1 Master the technology related to the whole process of Surveying and Mapping Engineering & 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	Introduction to Computational Thinking、CAD Basic and Application、GIS base Application Skill、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、Map Design and Compilation.
	3.2 Be able to complete the design of Surveying and Mapping Engineering & Navigation system and production process according to specific requirements	GNSS Programming、CAD Basic and Application、Principle of Geographic Information System、Photogrammetry Practice、Application and Principles of GNSS、Application and Technology of Laser Radar Surveying、Engineering Surveying、Comprehensive Practice for Satellite Navigation and Positioning、Surveying Program Design Practice Contest.
	3.3 Be able to design the Surveying and Mapping Engineering & Navigation system or production process, and embody the innovation consciousness in the design	Digital Topographic Surveying、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.

Graduate Abilities	Related Knowledge	Course Supports
	3.4 In the design of Surveying and Mapping Engineering & Navigation system or mapping production process, the constraints of safety, health, law, culture and environment can be considered	Introduction to Geomatics、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 through information synthesis.	4.1 Based on scientific principles, through literature research, using scientific methods, research and analyze the solutions of complex Surveying and Mapping Engineering & Navigation problems	Cartography、Principle of Geographic Information System、Foundation of Geodesy、Engineering Surveying、Introduction to Smart City、Geographic Conditions Monitoring、Practical Training for Remote Sensing Principles、Cartography Practice、Practical Training for Satellite Navigation and Positioning.
	4.2 According to the characteristics of Surveying and Mapping Engineering & Navigation objects, the research route can be selected and the technical scheme of Surveying and Mapping Engineering & Navigation can be designed	Introduction to Computational Thinking、Engineering Drawing and Interpreting、Application and Principles of Remote Sensing、Photogrammetry、Application and Principles of GNSS、Comparative Practical Training for Navigation and Positioning.
	4.3 It can construct the experimental system according to the technical scheme of	GNSS Programming、Application and Technology of Laser Radar Surveying、Practical Training for Satellite Navigation and Positioning、Surveying Programming Contest Practice、Practical Training for

Graduate Abilities	Related Knowledge	Course Supports
	Surveying and Mapping Engineering & Navigation, carry out the Surveying and Mapping Engineering & Navigation experiment safely, and collect the Surveying and Mapping Engineering & Navigation experimental data correctly	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 s Surveying and Mapping Engineering & Navigation instruments, information technology tools and Surveying and Mapping Engineering & Navigation software commonly used in surveying and mapping, and understand their limitations	Introduction to Computational Thinking、C Programming Language Design、CAD Basic and Application、C# Programming、Digital Topographic Surveying、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.

Graduate Abilities	Related Knowledge	Course Supports
	5.2 Be able to select and use appropriate modern Surveying and Mapping Engineering & Navigation instruments, information resources and Surveying and Mapping Engineering & Navigation software to carry out technical design, data processing and accuracy analysis for complex Surveying and Mapping Engineering & Navigation problems	Engineering Drawing and Interpreting、Digital Topographic Surveying、Practical Training for Remote Sensing Principles、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 Contest.
	5.3 It can develop or select modern Surveying and Mapping Engineering & Navigation instruments and information technology tools to meet specific needs for specific Surveying and Mapping Engineering & Navigation objects, predict and simulate complex Surveying and Mapping Engineering & Navigation problems, and analyze their limitations	Theory of Probability and Statistics (B)、College physics A(1-2)、Linear Algebra、Document Retrieval of Science and Technology、Fundamentals of Error Theory and Surveying Adjustment、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).

Graduate Abilities	Related Knowledge	Course Supports
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 Engineering & Navigation, and understand the influence of different social cultures on engineering activities	Thought Morals Accomplishment and Basic Law、Introduction to Civil Engineering、Digital Topographic Surveying、Application and Principles of Remote Sensing、Foundation of Geodesy、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 & 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 the Chinese characteristic socialism、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 map	7.1 Know and understand the concept and connotation of environmental protection and sustainable dev	Physics Experiment(1-2)、Introduction to Geomatics、Introduction to Earth Science、Remote Sensing Digital Image Processing、Geographic Conditions Monitoring、Natrual Resources Management、Situation and Policy(1-4).

Graduate Abilities	Related Knowledge	Course Supports
ping engineering practice on the environment and social sustainable development.	elopment	
	7.2 From the perspective of environmental protection and sustainable development, we can think about the sustainability of Surveying and Mapping Engineering & Navigation 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 & Navigation engineering	Marketing Management、Introduction to Earth Science、Real Estate Surveying and Management、Introduction to Smart City、Geographic Conditions Monitoring、Deformation Monitoring and Disasters Predicting、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	Thought Morals Accomplishment and Basic Law、The Outline of the Modern Chinese History、The Generality of Basic Principle of Marxism、Introduction to Mao Zedong Thoughts and Theoretical System of the Chinese characteristic socialism、Physical Education(1-4).
	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 p	Thought Morals Accomplishment and Basic Law、The Outline of the Modern Chinese History、Introduction to Mao Zedong Thoughts and Theoretical System of the Chinese characteristic socialism、College Student Occupation Career and Development Planning、Introduction to Geomatics、Surveying Management and Laws、Situation and Policy(1-4)、Digital Topographic Surveying Practice、Practi

Graduate Abilities	Related Knowledge	Course Supports
	ractice of Surveying and Mapping Engineering & Navigation projects	cal Training for Real Estate Surveying and Management、Comprehensive Practice for Navigation and Positioning.
	8.3 Understand the social responsibility of Surveying and Mapping Engineering & Navigation workers for public safety, health, well-being and environmental protection, and be able to consciously perform their responsibilities in Surveying and Mapping Engineering & Navigation engineering practice	The Generality of Basic Principle of Marxism、College Student Occupation Career and Development Planning、Situation and Policy(5-8)、Introduction to Geomatics、Introduction to Earth Science、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	College Student Occupation Career and Development Planning、Physical Education(1-4)、Introduction to Civil Engineering、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 Training for Engineering Surveying、Practical Training for Laser Radar Surveying Technology、GIS Software Development Practice.
	9.3 Ability to organi	The Outline of the Modern Chinese History、Cart

Graduate Abilities	Related Knowledge	Course Supports
	ze, coordinate and direct the work of the team	ography Practice、GIS Practice、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 Engineering & Navigation peers and the public in written statements and statements on Surveying and Mapping Engineering & Navigation technology design book and survey technology summary	Cartography Practice、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 Engineering & Navigation, and understand and respect the differences and diversity of different cultures	College English(1-2)、English Country Culture、Principle of Geographic Information System、Comprehensive Practice for Spatial Information、Application of Modern Surveying and Mapping Technology、GIS base Application Skill、Remote Sensing Application Prospect.
	10.3 Have the ability of cross-cultural communication langua	College English(1-2)、Scientific Paper writing、Oral English、Selected readings of English Newspapers、 English for Specific Purposes、Engineering

Graduate Abilities	Related Knowledge	Course Supports
	ge and written expression, and be able to carry out basic communication and exchange on Surveying and Mapping Engineering & Navigation professional issues under the cross-cultural background	Practice、Compound Training、Cross-cultural credit requirements for the second classroom (participation in international conferences, exhibitions and volunteers, 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 the project	Introduction to Civil Engineering、Marketing Management、Real Estate 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 & Navigation 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 develop	Comparative Practical Training for Engineering Surveying、Practical Training for Real Estate Surveying and Management、Conspectus of Urban Planning、Graduation design.

Graduate Abilities	Related Knowledge	Course Supports
	ing Surveying and Mapping Engineering & Navigation scheme, the method of engineering management and economic decision-making can be used	
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	Thought Morals Accomplishment and Basic Law、College Student Occupation Career and Development Planning、English for Specific Purposes、Appreciation of Famous British and American Literature、Introduction to Geomatics、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 Engineering & 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 the Chinese characteristic socialism、Introduction to Earth Science、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（智能导航实验班）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	延续教学	开课学期	教学单位
通识教育课	必修	思想道德修养与法律基础 Thought Morals Accomplishment and Basic 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
		马克思主义基本原理概论★ The Generality of 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体系理论概论★ Introduction to Mao Zedong Thoughts and Theoretical System of the Chinese characteristic socialism	5	80	64			16		4	马克思主义学院
		形势与政策(1-4) Situation and Policy(1-4)	2	32	16			16		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					1/2	学工部
		大学生心理健康 The Mental health of College Students	1	16	16					1/2	学工部
		大学英语(1-2) ★ College English(1-2)	6	128	96				32	1-2	人文学院
		口语	2	32	32					3	文法学院
		大学英语四级强化	2	32	32					3	文法学院
		大学英语六级提高	2	32	32					3	文法学院
		英语报刊选读	2	32	32					3	文法学院
		英语国家文化	2	32	32					4	文法学院
		英美文学名篇赏析	2	32	32					4	文法学院
		专门用途英语	2	32	32					4	文法学院
		升学英语考试	2	32	32					4	文法学院
		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
		小 计	33.5	656	544			80	32		
	核心	建筑艺术与城市设计	2	32						1-8	各院部
		哲学视野与人文素养	2	32						1-8	各院部
		创新创业与社会发展	2	32						1-8	各院部
		生态文明与智慧科技	2	32						1-8	各院部
		至少修读 4 类合计 8 学分，每类至少修读 2 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
		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
	跨类任选至少 2 学分										
	通识教育课合计至少修读 43.5 学分，其中通识教育必修 33.5 学分（其中口语、大学英语四级强化、大学英语六级提高、英语报刊选读必选 2 学分，英语国家文化、英美文学名篇赏析、专门用途英语、升学英语考试必选 2 学分），通识教育核心 8 学分，通识教育任选 2 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	52			4		2	理学院
		普通物理 A（2）★ College physics A(2)	3	52	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	3	48	24	24				1	遥感科学与技术系
		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
		导航装备基础 Foundation of Navigation Equipment	2.5	40	36	4				2	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	2	32	24	8				3	地理信息科学系
		地理信息系统原理(双语)★ Principle of Geographic Information System	2	32	24	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	遥感科学与技术系
		小 计	44.5	772	612	132		8	28		
	大类基础课合计必修 44.5 学分										
专业核心课	必修	GNSS 原理及其应用★ Application and Principles of GNSS	3	48	44	4				3	测绘工程系
		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
		大地测量学基础★ Foundation of Geodesy	3	48	40	8				4	测绘工程系
		摄影测量学★ Principles of Photogrammetry	2	32	32					5	遥感科学与技术系
		工程测量学★ Engineering Surveying	3	48	40	8				6	测绘工程系
		小计	14	224	204	20					
	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	嵌入式系统与程序设计 Embedded System and Programming	3	48	48					3	地理信息科学系
		GNSS 程序设计 Programming for GNSS	2	32	24	8				4	测绘工程系
		变形监测与灾害预报 Deformation Monitoring and Disasters Predicting	2	32	24	8				5	测绘工程系
		高精度导航地图与位置服务 High-Precision Navigation Map and Location Service	2	32	32					5	测绘工程系
		激光雷达测量技术与应用 Application and Technology of Laser Radar Surveying	2	32	24	8				7	测绘工程系
		小 计	11	176	152	24					
	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
		测量程序设计与数据处理 Surveying Programming Design and Data Processing	2	32	16	16				5	测绘工程系
		科技文献检索 Document Retrieval of Science and Technology	1	16	16			8		5	图书馆
		土木工程概论（限选） Introduction to Civil Engineering	3	48	48					5	土木学院
		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
		室内定位与智能导航（限选） Indoor Positioning and Intelligent Navigation	2	32	28	4				6	地理信息科学系
		计算机图形学（限选） Computer Graphics	2	32	24	8				6	地理信息科学系
		工业智能定位测量 （限选） Industrial Intelligent Positioning Survey	2	32	32					6	测绘工程系
		城市遥感（双语） Urban Remote Sensing	2	32	24	8				6	遥感工程系
		科技论文写作（双语） Scientific Paper writing	1	16	16					6	测绘工程系
专业方向课	选修	智慧城市导论 Introduction to Smart City	1	16	16					6	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
		自然资源管理 Natural Resource Management	1	16	16					7	
		不动产测量与管理 （限选）Real Estate Surveying and Management	2	32	28	4				7	测绘工程系
		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	35.5	568	484	84		8			
	专业方向课合计 29 学分，必修 11 学分，任选至少修读 18 学分										

表 2　测绘工程（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					
	形势与政策（5-8）Situation and Policy(5-8)	0	32			5-8	分散	马院、各学院
	导航装备基础实习 Foundation of Navigation Equipment Pratice	1	20	20		2	17	测绘工程系
	数字地形测量实习 Digital Topographic Surveying Practice	3	60	60		2	18-20	测绘工程系
	卫星导航定位实习 Practical Training for Satellite Navigation and Positioning	2	40	40		3	17-18	测绘工程系
	地图学实习 Cartography Practice	1	20	20		3	19	地理信息科学系
	地理信息系统原理实习 GIS Practice	1	20		20	3	20	地理信息科学系
	导航定位嵌入式研发实习 Navigation and Positioning Embedded Research and Development Practice	1	20		20	4	17	测绘工程系
	遥感原理实习 Practical Training for Principles of Remote Sensing	1	20	20		4	18	遥感科学与技术系
	控制测量实习 Practical Training for Control Surveying	2	404	60		4	19-20	测绘工程系
	高精度地图采集实习 High-precision Map Collection Practice	1	20	20		5	19	测绘工程系
	摄影测量实习 Photogrammetry Practice	1	20	20		5	20	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
	工程测量综合实习 Practical Training for Engineering Surveying	4	80	80		6	17-20	测绘工程系
	导航定位综合实习 Comprehensive Practice for Navigation and Positioning	5	120	120		7	1-5	测绘工程系
	激光雷达测量技术实习 Practical Training for Laser Radar Surveying Technology	1	20	10	10	7	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	37	1224	650	50			
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		1-3		测绘学院
		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		4-5		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
		科研团队创新训练-团队协作与创新创业能力实训 Innovation Training Project of Scientific Research Team	1	20	20		6-7		测绘学院
		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		测绘学院
		测量程序设计大赛实训 Surveying Programing Contest Practice	1	20	20		5		测绘工程系
		测绘科技论文写作大赛 College Students Paper Contest of Surveying and Mapping Science and Technology	1	20	20		5		测绘学院
		北斗创新创业大赛 Beidou Innovation and Entrepreneurship Contest	1	20	20		5		测绘工程系
		导航定位终端嵌入式程序设计大赛 Navigation and Positioning Terminal Embedded Programming Contest	1	20	20		4		测绘工程系
		“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				测绘工程系
	小 计		11	220	220				
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									

2020 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 166 学分，其中，理论课程 130 学分，实践教学环节 36 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	41.5	688	25%
	选修	2	32	1.2%
大类基础课	必修	43	756	25.91%
	选修	1	16	0.6%
专业核心课	必修	16	256	9.64%
专业方向课	必修	22	344	13.25%
	选修	4.5	72	2.71%
独立实践环节	必修	34	780	20.49%
	选修	2	40	1.2%
总计		166	2984	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

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）
		处理、摄影测量基础实习等。
	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	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	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	思想道德修养与法律基础、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	中国近现代史纲要、马克思主义基本原理概论、毛泽东思想和中国特色社会主义体

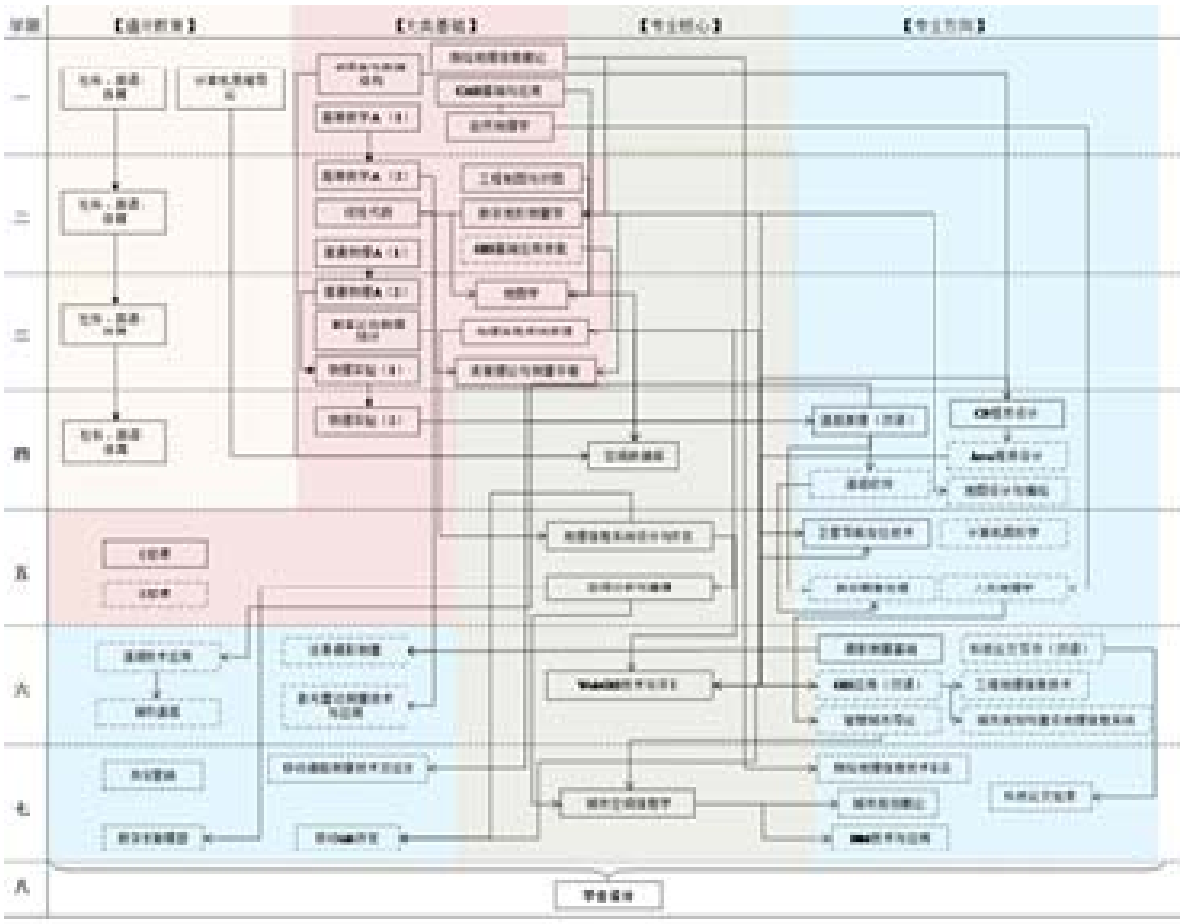
毕业生应具备的知识能力	相关知识领域	实现途径（课程支撑）
的责任。	地理空间信息工程问题、地理问题的解决方案对社会、健康、安全、法律以及文化的影响，以及这些制约因素对项目实施的影响，并理解应承担的责任	系理论概论、军事理论、工程测量学、城市空间信息学、城市地理学、经典赏析与文化传承、哲学逻辑与文明对话、科技革命与社会发展、建筑艺术与审美教育、生态文明与未来城市等。
7.环境和可持续发展：能够理解和评价针对复杂地理空间信息问题的地理空间信息工程实践对环境、社会可持续发展的影响。	7.1 知晓和理解环境保护和可持续发展的理念和内涵	物理实验（1-2）、测绘地理信息概论、地球科学概论、遥感数字图像处理、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	思想道德修养与法律基础、中国近现代史纲要、马克思主义基本原理概论、毛泽东思想和中国特色社会主义体系理论概论、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	思想道德修养与法律基础、中国近现代史纲要、毛泽东思想和中国特色社会主义体系理论概论、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概论、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	9.1 能与建筑、土木等	大学生职业生涯与发展规划、体育（1-4）、

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）
科背景下的团队中承担个体、团队成员以及责任人的角色。	学科的成员有效沟通，合作共事	工程力学、城市地理学、C#程序设计、毕业设计等。
	9.2 能够在团队中独立或合作开展工作	军事理论、军训、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、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	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。

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）
	济决策方法	
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	思想道德修养与法律基础、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概论、毛泽东思想和中国特色社会主义体系理论概论、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



2020 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 166, including 130 credits of theoretical courses and 36 credits of practice teaching.

VII Proportion of Course

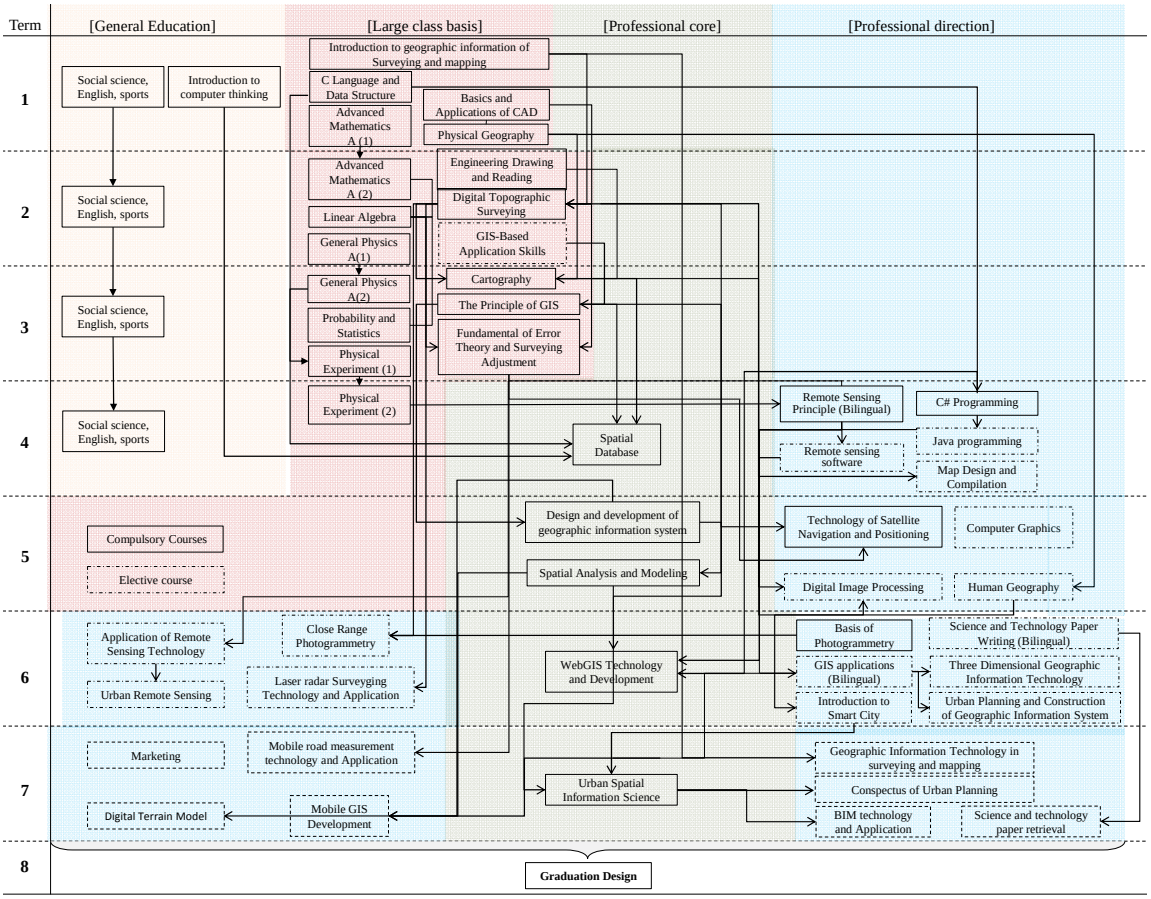
Course Category	Course Type	Credits	Class Hour	Proportion
General Education	Compulsory	41.5	688	25%
	Optional	2	32	1.2%
Big Academic Subjects	Compulsory	43	756	25.91%
	Optional	1	16	0.6%

Course Category	Course Type	Credits	Class Hour	Proportion
Professional Core	Compulsory	16	256	9.64%
Professional Direction	Compulsory	22	344	13.25%
	Optional	4.5	72	2.71%
Practice	Compulsory	34	780	20.49%
	Optional	2	40	1.2%
Total		166	2984	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 Thoughts and Theoretical System of the Chinese characteristic socialism, Introduction to Mao

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.	Zedong Thoughts and Theoretical System of the Chinese characteristic socialism, 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 Thoughts and Theoretical System of the Chinese characteristic socialism, 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 Thoughts and Theoretical System of the Chinese characteristic socialism, 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 Thoughts and Theoretical System of the Chinese characteristic socialism, 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	延续教学	开课学期	教学单位
通识教育课	必修	思想道德修养与法律基础 Thought Morals Accomplishment and Basic 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
		马克思主义基本原理概论★ The Generality of 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体系理论概论★ Introduction to Mao Zedong Thoughts and Theoretical System of the Chinese characteristic socialism	5	80	64			16		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					1/2	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
		小 计	33.5	656	560			64	32		
	核心	建筑艺术与城市设计	2	32						1-8	各院部
		哲学逻辑与人文素养	2	32						1-8	各院部
		创新创业与社会发展	2	32						1-8	各院部
		生态文明与智慧科技	2	32						1-8	各院部
		至少修读 4 类合计 8 学分，每类至少修读 2 学分									
	任修	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
		跨类任选至少 2 学分									
	通识教育课合计至少修读 43.5 学分。 其中通识教育必修 33.5 学分，通识教育核心 8 学分，通识教育任选 2 学分（含体育课 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
		摄影测量学 Photogrammetry	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	1.5	24	16	8				5	地理信息科学系
		数据结构 Data Structure	1.5	24	16	8				5	地理信息科学系
		遥感数字图像处理 Remote Sensing Image Processing	1.5	24	16	8				5	遥感工程系
		计算机图形学 Computer Graphics	2	32	20	12				6	地理信息科学系
		工程制图与识图 Engineering Drawing and Read Drawing	2	32	32					6	理学院
		大数据与地理信息系统 Big Data and Geographic Information System	1.5	24	16	8				6	地理信息科学系
		CIM 技术与应用 CIM Technology and Application	2	24	16	8				7	地理信息科学系
		城市地理学 Urban geography	2	32	32					7	地理信息科学系
		小　计	22	344	268	76					

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	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
		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
		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	16						7	测绘学院
		测绘法律法规 SurveyingManagement and Laws	1	16						6	测绘学院
		小计	30	488	316	140		8			
	专业方向课合计 26.5 学分，必修 22 学分，任选 4.5 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			3	17-18	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
	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
	遥感原理与应用实习 Principles of Remote Sensing Practice	1	20			3	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	34	780	340				

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
课外	创新实践及科研训练	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
		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 36 学分，课内必修 34 学分，创新实践及科研训练选修 2 学分									

2020 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：

面向首都及国家城乡建设的需要，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，能够在国土资源调查、国家基础测绘、城乡建设与规划、自然资源监测、环境保护、文化遗产保护及灾害预警与应急响应等领域从事地面、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和科学文化素养，较强的工作责任心，事业心、良好的职业道德，能够承担和履行社会责任，能积极服务于国家与社会。

（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工程中担任重要角色。

（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及注册测绘师的能力，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和学校土木建筑类学科和学院测绘学科背景优势，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“编程能力”。第二，确保学生具有摄影测量遥感的生产实践能力。此外，结合学院的研究特色方向，在地面激光扫描文化遗产保护、移动道路测量系统应用等方面的课程突出优势和特色。

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 167.5 学分，其中理论课程 128.5 学分，实践教学环节 39 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	41.5	688	24.78%
	选修	2	32	1.19%
大类基础课	必修	43	756	25.67%
	选修	1	16	0.6%
专业核心课	必修	14	224	8.36%
专业方向课	必修	21.5	344	12.84%
	选修	5.5	88	3.28%
独立实践环节	必修	39	880	23.28%
总计		167.5	3028	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，粗体为必修课）
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	C 语言程序设计、地图学、数据结构、工程制图与识图、高等数学 A(1-2)、概率与数理统计 B、线性代数、普通物理 B(1-2)、工程制图与识图、CAD 基础与应用、遥感原理与应用、遥感数字图像处理、地球科学概论、大地测量基础、计算机图形学等。
	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、概率与数理统计 B、普通物理 B(1-2)、数字地形测量学、地理信息系统原理（双语）、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	高等数学 A(1-2)、线性代数、遥感数字图像处理、工程制图与识图、GNSS 原理及其应用、激光雷达测量技术与应用、微波遥感、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	概率与数理统计 B、近景摄影测量、遥感技术应用、摄影测量学、摄影测量学实习、新技术实习、空间信息综合实习、毕业设计等。
2.问题分析：能够应用数学、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、分析与表达遥感复杂工程问题	计算思维导论、C 语言程序设计、高等数学 A(1-2)、概率与数理统计 B、线性代数、普通物理 B(1-2)、工程制图与识图、CAD 基础与应用、地图学、地理信息系统原理（双语）、面向对象的程序设计、遥感数字图像处理、大地测量基础等。
	2.2 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	科技文献检索、大地测量学基础、遥感技术应用、城市遥感（双语）、摄影测量学、面向对象的程序设计等。

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，粗体为必修课）
	可替代的解决方案	
	2.3 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	科技文献检索、GNSS 原理及其应用、近景摄影测量、遥感原理等。
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	地理信息系统原理（双语）、遥感数字图像处理、遥感软件、可视化语言 IDl、计算机视觉、GIS 软件使用、地理信息系统原理实习、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系统	遥感软件、遥感技术应用、移动道路测量技术及应用 、GIS 软件使用、GNSS 原理及其应用、激光雷达测量技术与应用、航空航天数据获取实习、面向对象的程序设计、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，考虑社会、健康、安全、法律、文化以及环境等因素	生态文明与未来城市、数字地形测量学、测绘地理信息概论、遥感技术应用、移动道路测量技术及应用、智慧城市导论、遥感科学与技术创新实践及科研训练、数字地形测量实习、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	地图学、地理信息系统原理（双语）、科技文献检索、航空航天数据获取、摄影测量学、近景摄影测量、微波遥感、遥感数字图像处理、遥感数字图像处理实习等。
	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	GNSS 原理及其应用、遥感原理与应用、遥感技术应用、遥感综合实习、空间信息综合实习、近景摄影测量等。
	4.3能够采用科学方法实施数据采集与分析	CAD 基础与应用、误差理论与测量平差基础、激光雷达测量技术与应用、摄影

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，粗体为必修课）
	处理	测量基础、摄影测量学实习、航空航天数据获取。
	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	物理实验（1-2）、数字地形测量实习、地图学、激光雷达测量技术与应用、遥感图像解译、空间信息综合实习等。
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。	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	现代测绘技术应用、数字地形测量学、GIS 基础应用技能、摄影测量学实习、航空航天数据获取、地图学实习、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、GIS 软件开发大赛实训等。
	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	GIS 基础应用技能、数字地形测量实习、遥感原理与应用实习、大地测量学基础、GNSS 原理及其应用、误差理论与测量平差基础、航空航天数据获取、地理信息系统原理实习、空间信息综合实习、毕业设计等。
	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	遥感软件、微波遥感、误差理论与测量平差基础、高光谱遥感、遥感综合实习、GIS 软件设计与使用、新型航空遥感数据处理技术、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，能够基于工程相关背景知识进行合理分析	测绘管理与法律法规、思想道德修养与法律基础、数字地形测量学、遥感原理与应用、大地测量学基础、GNSS 原理及其应用、测绘地理信息概论、遥感图像解译等。
	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	思想道德修养与法律基础、马克思主义基本原理概论、中国近现代史纲要、毛泽东思想和中国特色社会主义体系理论概论、空间信息综合实习、军事理论、科技革命与社会发展、生态文明与未来

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，粗体为必修课）
	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	城市、形势与政策（1-2）、遥感综合实习、毕业设计等。
7. 环境和可持续发展：能够理解和评价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	毛泽东思想和中国特色社会主义体系理论概论、测绘地理信息概论、地球科学概论、地理国情监测、形势与政策（1-2）、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，以及评价遥感 工程生产实践中可能对环境及社会造成的损害和隐患	生态文明与未来城市、地理国情监测、地球科学概论、智慧城市导论、形势与政策（1-2）、自然地理地貌与遥感解译实习等。
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解并遵守测绘、地理信息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 和健康的体魄，树立正确的世界观、人生观和价值观	思想道德修养与法律基础、中国近现代史纲要、马克思主义基本原理概论、毛泽东思想和中国特色社会主义体系理论概论、军事理论、体育（1-4）、军训、大学生职业生涯与发展规划、形势与政策（1-2）、经典赏析与文化传承、哲学视野与文明对话、科技革命与社会发展等。
	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	思想道德修养与法律基础、毛泽东思想和中国特色社会主义体系理论概论、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、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	思想道德修养与法律基础、中国近现代史纲要、马克思主义基本原理概论、毛泽东思想和中国特色社会主义体系理论概论、大学生职业生涯与发展规划、测

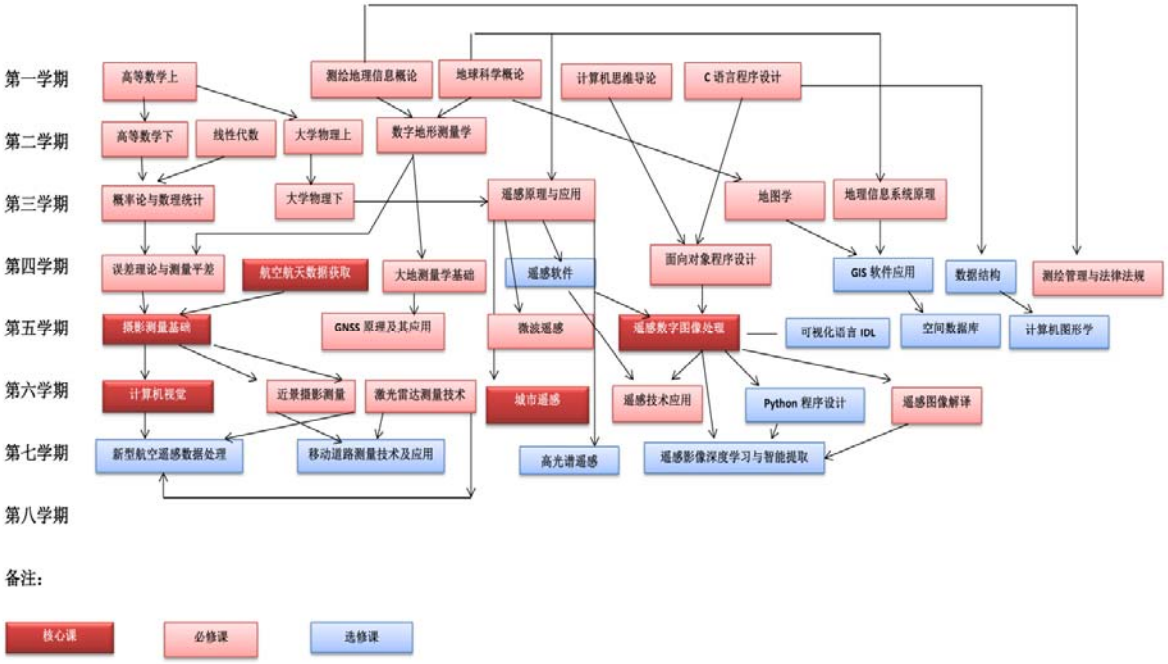
毕业生应具备的知识能力	相关毕业要求指标点	实现途径（课程支撑，粗体为必修课）
	实践中自觉履行责任	绘管理与法律法规、测绘地理信息概论、地球科学概论、自然地理地貌及遥感图像解译实习、城市遥感等。
9. 个人和团队：能够在多学科背景下的团队中承担个体、团队成员以及责任人的角色。	9.1 能与测绘、地理信息、计算机 等学科的成员有效沟通，合作共事	工程制图与识图、地球科学概论、计算机视觉、面向对象的程序设计、遥感图像解译等。
	9.2 能够在团队中独立或合作开展工作	军事理论、军训、数字地形测量实习、遥感原理与应用实习、新技术实习、GIS软件开发大赛实训等。
	9.3 能够组织、协调和指挥团队开展工作	数字地形测量实习、地图学实习、地理信息系统原理实习、航空航天数据获取、空间信息综合实习、新技术实习、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。	地图学实习、城市遥感（双语）、科技论文写作（双语）、遥感数字图像处理实习、面向对象程序设计实习、遥感科学与技术创新实践及科研训练、毕业设计等。
	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）、城市遥感（双语）、地理信息系统原理（双语）、新型航空遥感数据处理、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，能够就遥感问题在跨文化背景下进行沟通和交流	大学英语（1-2）、口语、英语国家文化、专门用途英语、科技论文写作（双语）、城市遥感（双语）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，粗体为必修课）
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、现代测绘技术应用、航空航天数据获取实习、（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、激光雷达测量技术与应用、现代测绘技术应用、遥感应用前景、（近景与激光雷达、移动测量、微波遥感）新技术实习**
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、测绘地理信息概论、测绘管理与法律法规、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	大学生职业生涯与发展规划、智慧城市导论、遥感应用前景、新型航空遥感数据处理技术、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。

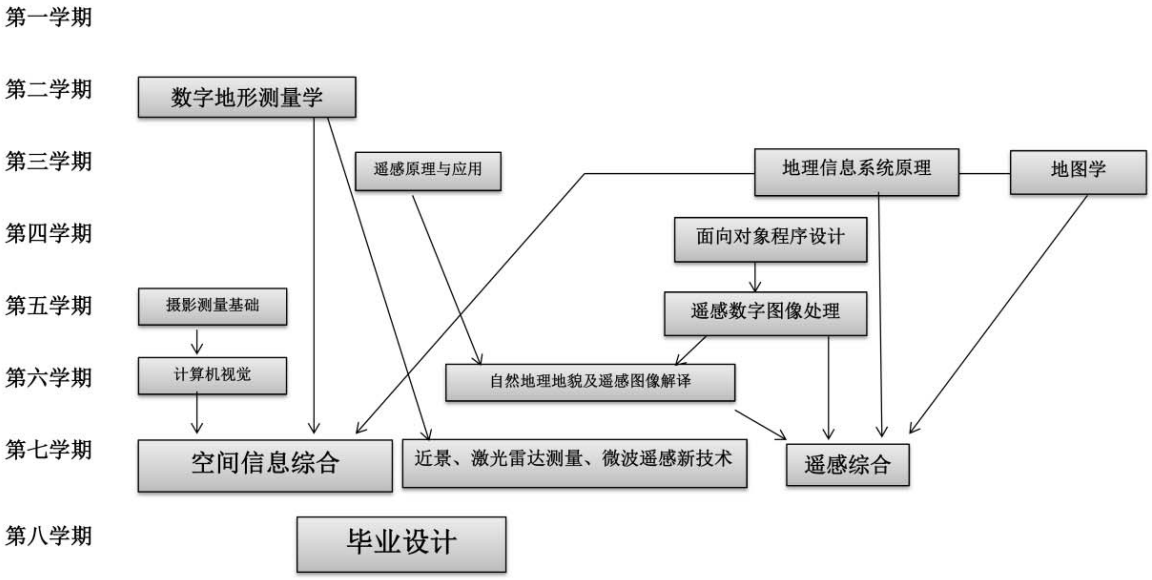
十、指导性教学计划（见附表）

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

2020 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 urban and rural construction of the capital and the country, advanced knowledge of mathematics, humanities and Social Sciences, basic theory, basic knowledge and basic skills of Remote Sensing Science and technology should be cultivated, accept training of scientific thinking and engineering practice, and have strong ability of acquisition, processing, analysis, application of remote sensing data in aviation, aerospace and on the ground, processing and development of remote sensing image and international vision Professional backbone and leading talents. After about 5 years of work and study after graduation, the following goals can be achieved:

(1) With good ideological and moral cultivation, scientific and cultural literacy, strong sense of responsibility, able to undertake and fulfill social responsibility.

(2) With organization management and coordination ability, good team consciousness, international vision and communication ability, able to solve complex remote sensing engineering problems and play an important role in the project.

(3) With the ability of lifelong learning and following the development of new technologies in the field of remote sensing, mastering the use of modern tools and software, it has competitive potential.

(4) Have the ability of engineer in surveying and mapping geographic information industry, and be competent for the production, management, development, research and education in the fields of geospatial information collection and processing, information-based surveying and mapping, natural resource investigation and monitoring, and urban emergency. Become the technical director or technical backbone of relevant enterprises and institutions in the field of remote sensing.

Features: This program relies on the background advantages of capital construction and civil construction discipline of the University and surveying and mapping discipline of the college, and pays attention to the penetration and construction of solid photogrammetry and remote sensing system courses. Two abilities of students should be cultivated: first, we should pay attention to "original ability" and "programming ability" in each teaching link. Second, to ensure that students have the ability of production and practice of photogrammetry and remote sensing. In addition, combined with the research characteristic

direction of the college, the courses in the aspects of ground laser scanning cultural heritage protection, mobile road measurement system application and so on have outstanding advantages and characteristics.

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 167.5, including 128.5 credits of theoretical courses and 39 credits of practice teaching.

VI Proportion of Course

Course Category	Course Type	Credits	Class Hour	Proportion
General Education	Compulsory	41.5	688	24.78%
	Optional	2	32	1.19%
Big Academic Subjects	Compulsory	43	756	25.67%
	Optional	1	16	0.6%
Professional Core	Compulsory	14	224	8.36%
Professional Direction	Compulsory	21.5	344	12.84%
	Optional	5.5	88	3.28%
Practice	Compulsory	39	880	23.28%
total		167.5	3028	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:	Introduction to computational thinking, C language, engineering drawing and map recognition, advanced mathematics a (1-2), General Physics A (1-2), physical geography, etc.
	1.2 be able to build mathematical model for specific remote sensing objects	Probability and Mathematical Statistics B, principle of geographic information system (Bilingual), photogrammetry basis, geodesy basis, error theory and survey adjustment basis, remote sensing principle, 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, lidar measurement technology and application, microwave remote sensing, digital photogrammetry, 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	Physical experiment (1-2), close range photogrammetry, application of remote sensing technology, basic practice of photogrammetry, comprehensive practice of spatial information, graduation design, etc.

Graduate Abilities	Related Knowledge	Course Supports
	sensing	
2. Problem analysis: be able to apply the basic principles of mathematics, physics and Geosciences to identify, express and analyze complex remote sensing engineering problems through literature research, so as to obtain effective conclusions.	2.1 be able to apply the basic theories of mathematics, physics and Geosciences to identification, analysis and expression.	Introduction to computational thinking, C language and data structure, probability and Mathematical Statistics B, linear algebra, object-oriented programming, deep learning and pattern recognition, etc.
	2.2 be able to correctly express complex remote sensing engineering problems based on relevant scientific principles and mathematical model methods	Scientific and technological literature retrieval, geodetic basis, remote sensing technology application, urban remote sensing, microwave remote sensing, remote sensing integrated practice, 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.
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 innovation awareness in the design process,	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.	Principles of geographic information system (Bilingual), introduction to smart city, remote sensing software, use of GIS software, practice of principles of geographic information system, comprehensive practice of spatial information, etc.
	3.2 be able to design and develop production processes and systems that	Remote sensing software, remote sensing technology application, GIS software use, object-oriented programming, remote sensing

Graduate Abilities	Related Knowledge	Course Supports
and consider social, health, safety, legal, cultural and environmental factors.	meet specific remote sensing needs	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..	Ecological civilization and future city, introduction to surveying and mapping geographic information, digital photogrammetry, mobile road survey technology and application, introduction to smart city remote sensing science and technology innovation practice, scientific research training, graduation project, etc.
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, aerospace data acquisition, close range photogrammetry, microwave remote sensing, hyperspectral remote sensing, etc.
	4.2 be able to design, demonstrate and predict the research scheme based on professional theoretical knowledge	Satellite navigation and positioning technology, remote sensing technology application, remote sensing comprehensive practice, space information comprehensive practice, close range photogrammetry, etc
	4.3 be able to use scientific methods to implement data collection, analysis and processing	CAD basis and application, digital topographic survey, error theory and survey adjustment basis, lidar measurement technology and application, photogrammetry basic practice, aerospace data acquisition.
	4.4 be able to carry out information synthesis and evaluation on the experimental results, and obtain reasonable and effective conclusions	Physical experiment (1-2), satellite navigation and positioning technology, lidar measurement technology and application, digital topographic measurement practice, aerospace data acquisition practice, etc.
5. Using modern tools: be able to develop, select and use appropriate remote sensing, mapping	5.1 be able to select appropriate modern remote sensing technology and hardware, software	Modern surveying and mapping technology application, GIS basic application skills, photogrammetry basic practice, aerospace Data Acquisition Remote Sensing comprehensive practice, (close range and lidar, mobile

Graduate Abilities	Related Knowledge	Course Supports
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.		measurement, microwave remote sensing) new technology practice, GIS software development competition 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	Cartography, GIS basic application skills digital topographic survey practice, aerospace data acquisition, GIS principle practice, spatial information comprehensive practice, graduation project, etc.
	5.3 be able to use modern tools to predict and simulate complex remote sensing engineering problems, and understand their limitations	Remote sensing software, microwave remote sensing, hyperspectral remote sensing, design and use of GIS software, new air remote sensing data processing technology, 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	Ideological and moral cultivation and legal basis, engineering drawing and map recognition, cartography, survey of geographic information, geodetic basis, 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	The outline of modern Chinese history, the introduction to the basic principles of Marxism, military theory, classic appreciation and cultural heritage, philosophical vision and civilization dialogue, scientific and technological revolution and social development, architectural art and aesthetic education, ecological civilization and future urban graduation design, etc

Graduate Abilities	Related Knowledge	Course Supports
	implementation, and understand the responsibilities to be undertaken	
7.Environment and sustainable development : be able to understand and evaluate 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	Introduction to Mao Zedong Thought and socialist system with Chinese characteristics, introduction to surveying and mapping geographic information, physical geography, situation and policy (1-2), physical geography and remote sensing interpretation practice, etc.
	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 evaluate the possible damages and hidden dangers to the environment and society caused by the production practice of remote sensing engineering	Ecological civilization and future city, physical geography, introduction to smart city, physical geography and geomorphology and remote sensing interpretation practice, cartography practice, 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	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, outline of modern Chinese history, introduction to basic principles of Marxism, introduction to Mao Zedong Thought and theory of socialism with Chinese characteristics, military theory, physical education (1-4), military training, classic appreciation and cultural heritage, philosophical vision and civilization dialogue, scientific and technological revolution and social development, etc

Graduate Abilities	Related Knowledge	Course Supports
geographic information industry in the practice of remote sensing engineering, and fulfill their responsibilities.	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, survey of geographic information, situation and policy (1-2), digital topographic survey practice, remote sensing comprehensive practice, remote sensing principle 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 consciously perform their responsibilities in the practice of remote sensing engineering	College Students' career and development planning, introduction to surveying and mapping geographic information, physical geography, remote sensing principle practice, physical geography and geomorphology and remote sensing image interpretation practice, urban remote sensing, etc.
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	College Students' career and development planning, introduction to smart city, comprehensive practice of spatial information, graduation project, etc.
	9.2 be able to work independently or cooperatively in the team	Cartography practice, GIS principle practice, remote sensing digital image processing practice, new technology practice, Zetai cup national paper competition, GIS software development competition practice, etc.
	9.3 be able to organize, coordinate and command the team to carry out the work	Military training, digital topographic survey practice, digital topographic survey practice, aerospace data acquisition, space information comprehensive practice, new technology

Graduate Abilities	Related Knowledge	Course Supports
		practice, college 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), cartography practice, remote sensing digital image processing practice, object-oriented programming practice, remote sensing science and technology innovation practice and scientific research training, 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), scientific and Technological Paper Writing (Bilingual), urban remote sensing (Bilingual), principles of geographic information system (Bilingual), College English expansion courses (1-8), new aviation remote sensing data processing, in-depth learning and pattern recognition introduction, remote sensing application prospect, etc.
	10.3 have the ability of cross-cultural communication in language and written expression, be able to communicate and exchange on remote sensing issues in cross-cultural context	College English (1-2), scientific and Technological Paper Writing (Bilingual), urban remote sensing (Bilingual), College English expansion courses (1-8), etc.
11. Project management: understand and master engineering management principles and economic	11.1 master the management and economic decision-making methods involved in engineering projects	Digital topographic survey, modern mapping technology application, aerospace data acquisition practice, (close range and lidar, mobile measurement, microwave remote sensing) new technology practice, etc.
	11.2 understand the cost composition of remote	Modern surveying and mapping technology application, aerospace data acquisition

Graduate Abilities	Related Knowledge	Course Supports
decision-making methods, and be able to apply them in a multidisciplinary environment.	sensing and mapping production, and understand the engineering management and economic decision-making issues involved in it	practice, remote sensing comprehensive practice, space information comprehensive practice, graduation project, 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 computational thinking, scientific and technological revolution and social development, application prospect of remote sensing, application of modern surveying and mapping technology, etc.
	12.2 Have the ability of eternal learning and adapting development.	Introduction to smart city, remote sensing application prospect, new air remote sensing data processing technology, introduction to deep learning and pattern recognition, graduation project, remote sensing science and technology innovation practice and 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	延续教学	开课学期	教学单位
通识教育课	必修	思想道德修养与法律基础 Thought Morals Accomplishment and Basic 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
		马克思主义基本原理概论★ The Generality of 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体系理论概论★ Introduction to Mao Zedong Thoughts and Theoretical System of the Chinese characteristic socialism	5	80	64			16		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					1/2	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) ★ 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		1/2	电信学院
		小 计	33.5	656	560			64	32		
	核心	建筑艺术与城市设计	2	32						1-8	各院部
		哲学逻辑与人文素养	2	32						1-8	各院部
		创新创业与社会发展	2	32						1-8	各院部
		生态文明与智慧科技	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
		跨类任选至少 2 学分									
	通识教育课合计至少修读 43.5 学分。 其中通识教育必修 33.5 学分，通识教育核心 8 学分，通识教育任选 2 学分（含体育课 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 Application Prospect	1	16	16					3	遥感工程系
		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	遥感工程系
		城市遥感（双语） Urban Remote Sensing	3	48	40	8				6	遥感工程系
		摄影测量学 Photogrammetry	3	48	44	4				5	遥感工程系
		遥感数字图像处理 Digital Image Processing	3	48	40	8				5	遥感工程系
		计算机视觉 Computer vision	3	48	40	8				6	遥感工程系
		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	GNSS 原理及其应用 GNSS principle and application	2	32	28	4				5	测绘工程系
		面向对象程序设计 object oriented programming	2	32	32					4	遥感工程系
		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
		激光雷达测量技术与应用 Laser radar Surveying Technology	2	32	24	8				6	遥感工程系
		遥感技术应用(研讨式教学)Applications of Remote Sensing in different fields (seminar)	2	32	16	16				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
		微波遥感 Microwave Remote Sensing	2	32	32					5	遥感工程系
		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 Remote sensing image interpretation	1.5	24	24					6	遥感工程系
		工程制图与识图 Engineering Drawing and Interpreting	2	32	32					6	理学院
		测绘管理与法律法规 Surveying Management and Laws	1	16	16					6	测绘工程系
		小 计	21.5	344	302	42					
	选修	空间数据库 Spatial Database	2	32						5	地理信息科学系
		数据结构 Data structure	2	32						4	遥感工程系
		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
		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
		计算机图形学 Computer Graphics	2	32						5	地理信息科学系
		高光谱遥感 Hyperspectral remote sensing	2	32	24	8				6	遥感工程系
		科技论文写作（双语）Academic Writing (Billinguish)	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		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	遥感工程系
		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	遥感工程系
		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	遥感工程系
		Python 程序设计 Python Programming	2	32	16	16				6	遥感工程系
		地理国情监测 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	27	432	240	96		8			
	专业方向合计 27 学分，必修 21.5 学分，选修 5.5 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
	摄影测量学实习 Photogrammetry Fundamental Practice		1	20	20		5	18	遥感工程系
	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	遥感工程系
	计算机视觉实习 Computer vision practice		1	20	20		6	17	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
	遥感综合实习 Remote Sensing Comprehensive Practice		3	60	60		7	18-20	遥感工程系
	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
	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
	（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	遥感工程系
	面向对象程序设计实习 Object oriented programming Practice		2	40	40		4	19-20	遥感工程系
	毕业设计 Undergraduate Design or Thesis		8	160	160		8	1-16	遥感工程系
	小　计		37	840	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				遥感工程系
		全国论文大赛 National Paper Contest	1	20	20				遥感工程系
		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
	小　计		5	100	100				
实践环节合计 39　学分，其中课内 37 学分，课外 2 学分（创新实践及科研训练必修 2 学分）									