**2019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，培养具备数理基础和人文社科知识，掌握遥感科学与技术基础理论、基本知识和基本技能，接受科学思维和工程实践训练，具有较强的航空、航天和地面遥感数据获取、处理、分析、应用及遥感影像处理开发能力和国际视野的高级专业骨干和领军人才。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，能够承担和履行社会责任。

（2）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。

（3）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。

（4）具备测绘地理信息行业工程师能力，胜任地理空间信息采集与处理、信息化测绘、自然资源调查与监测及城市应急等领域等方面的生产、管理、开发、研究与教育工作。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语言与数据结构、自然地理学、地图学

2．主干专业课程

遥感原理、航空航天数据获取、摄影测量基础、遥感数字图像处理、城市遥感（双语）、数字摄影测量

**五、主要实践教学环节**

数字地形测量学实习、摄影测量基础实习、航空数据获取实习、遥感原理实习、遥感数字图像处理、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165学分，其中理论课程126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 | 40.5 | 608 | 24.5 |
| 选修 | 3.0 | 48 | 2 |
| 大类基础课 | 必修 | 46 | 764 | 28 |
| 选修 | 1 | 16 | 0.4 |
| 专业核心课 | 必修 | 14 | 224 | 8.4 |
| 专业方向课 | 必修 | 11 | 176 | 6.7 |
| 选修 | 10.5 | 168 | 6.4 |
| 独立实践环节 | 必修 | 39 | 780 | 23.6 |
| 总计 | | 165 | 2784 | 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 | 4-16周 | 17-18周 | 19-20周 | 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 | 1-16周 | 17周 | 18-20周 | 6 | 1-15，18-19周 | 20周 | 16-17周 |
| 7 | 7-14周 | 15周 | 1-6、16-20周 | 8 | 1-16毕业设计/实习 17周答辩 | | |

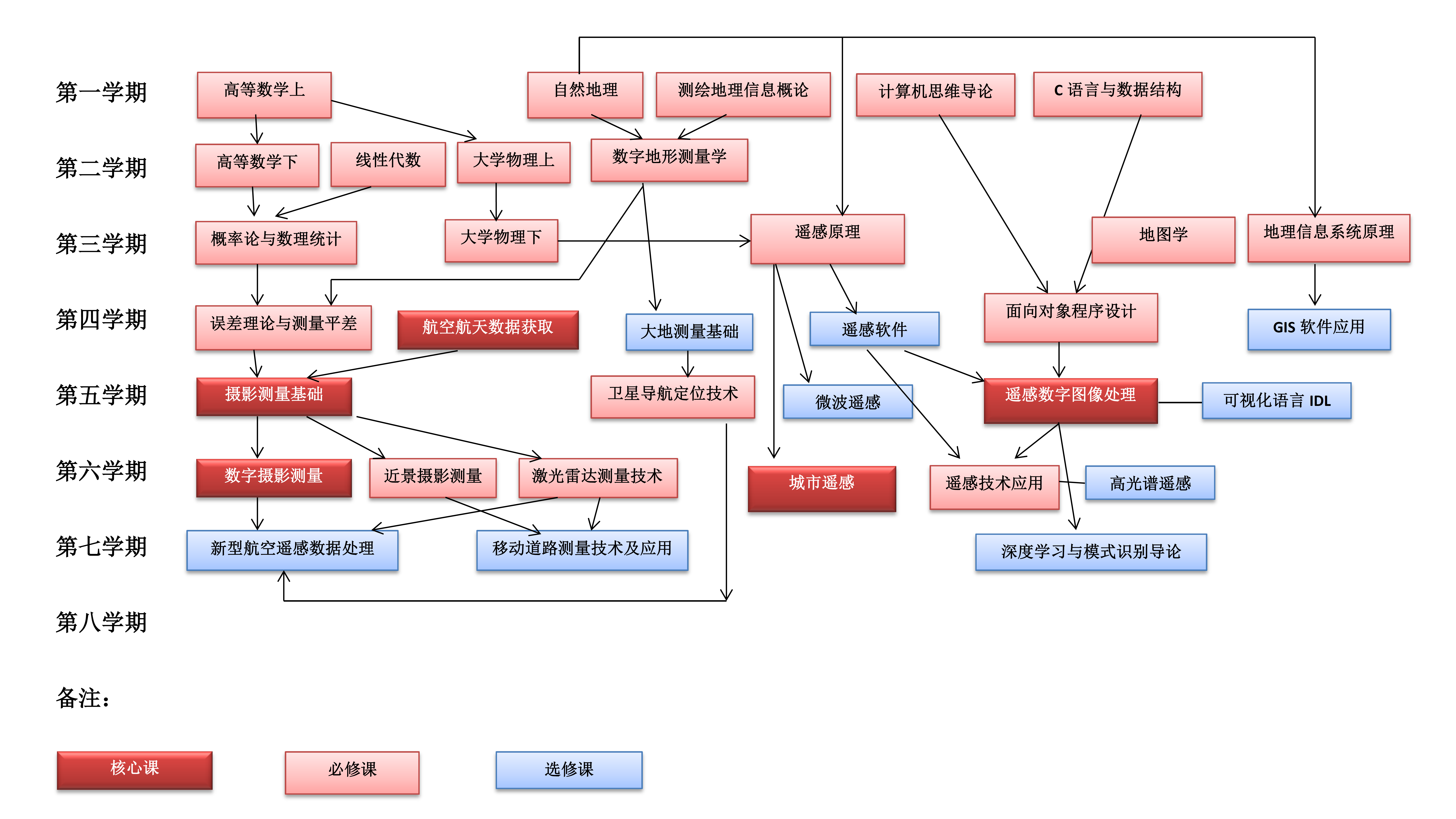
**九、毕业生应具备的知识能力及实现矩阵**

|  |  |  |
| --- | --- | --- |
| 毕业生应具备的知识能力 | 相关毕业要求指标点 | 实现途径（课程支撑） |
| 1.工程知识: 能够应用数学、物理、计算机、地学科学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、地学科学的语言工具用于遥感工程问题的表述 | 计算思维导论、C语言与数据结构、工程制图与识图、高等数学A(1-2)、普通物理A(1-2)、自然地理学等。 |
| 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 | 概率与数理统计B、地理信息系统原理（双语）、摄影测量基础、大地测量学基础、误差理论与测量平差基础、遥感原理等。 |
| 1.3能够将遥感相关知识和数学模型方法用于推演、分析遥感专业复杂工程问题 | 线性代数、遥感数字图像处理、激光雷达测量技术与应用、微波遥感、数字摄影测量等。 |
| 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 | 物理实验（1-2）、近景摄影测量、遥感技术应用、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、物理、地学科学的基本原理，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、地学科学的基本理论运用到识别、分析与表达 | 计算思维导论、C语言与数据结构、概率与数理统计B、线性代数、面向对象的程序设计、深度学习与模式识别等。 |
| 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可替代的解决方案 | 科技文献检索、大地测量学基础、遥感技术应用、城市遥感、微波遥感、遥感综合实习等。 |
| 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、近景摄影测量、遥感技术应用、新技术实习、毕业设计、科研训练等。 |
| 3.设计/开发解决方案：能够设计针对复杂遥感、摄影测量测绘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掌握测绘地理信息工程设计/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 | 地理信息系统原理（双语）、智慧城市导论、遥感软件、GIS软件使用、地理信息系统原理实习、空间信息综合实习等。 |
| 3.2能够设计开发满足特定遥感需求的生产流程及系统 | 遥感软件、遥感技术应用、GIS软件使用、面向对象的程序设计、遥感图像处理实习等。 |
| 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、测绘地理信息概论、数字摄影测量、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、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遥感工程问题提出研究方案 | 遥感原理、航空航天数据获取、近景摄影测量、微波遥感、高光谱遥感等。 |
| 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 | 卫星导航定位技术、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处理 | 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、摄影测量基础实习、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）、卫星导航定位技术、激光雷达测量技术与应用、数字地形测量实习、航空航天数据获取实习等。 |
| 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、资源、现代测绘仪器和遥感处理软件，包括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、GIS基础应用技能、摄影测量基础实习、航空航天数据获取遥感综合实习、（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 | 地图学、GIS基础应用技能数字地形测量实习、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、高光谱遥感、GIS软件设计与使用、新型航空遥感数据处理技术等。 |
| 6.工程与社会：能够基于工程相关背景知识进行合理分析，评价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 | 思想道德修养与法律基础、工程制图与识图 、地图学、测绘地理信息概论、大地测量基础等。 |
| 6.2能够评价遥感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，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 | 中国近现代史纲要、马克思主义基本原理概论、军事理论、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、建筑艺术与审美教育、生态文明与未来城市毕业设计等。 |
| 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、自然地理学、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、自然地理学、智慧城市导论、自然地理地貌与遥感解译实习、地图学实习等。 |
| 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、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 | 大学生职业生涯与发展规划、测绘地理信息概论、形势与政策（1-2）、数字地形测量实习、遥感综合实习、遥感原理实习等。 |
| 8.3理解遥感工作人员对公众的安全、健康、福祉、环境保护的社会责任，能够在遥感工程实践中自觉履行责任 | 大学生职业生涯与发展规划、测绘地理信息概论、自然地理学、遥感原理实习、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 | 大学生职业生涯与发展规划、智慧城市导论、空间信息综合实习、毕业设计等。 |
| 9.2能够在团队中独立或合作开展工作 | 地图学实习、地理信息系统原理实习、遥感数字图像处理实习、新技术实习、则泰杯全国论文大赛、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 | 军训、数字地形测量实习、数字地形测量实习、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能够在撰写设计书、技术报告以及陈述发言中，就复杂遥感工程问题与同行及社会公众进行有效沟通和交流 | 城市遥感（双语）、科技论文写作（双语）、地图学实习、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 | 大学英语（1-2）、科技论文写作（双语）、城市遥感（双语）、地理信息系统原理（双语）、大学英语拓展系列课程（1-8）、新型航空遥感数据处理、深度学习与模式识别概论、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）、科技论文写作（双语）、城市遥感（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 | 数字地形测量学、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、测绘生产的成本构成，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、航空航天数据获取实习、遥感综合实习、空间信息综合实习、毕业设计等。 |
| 12.终身学习：具有自主学习和终身学习的意识，有不断学习和适应发展的能力。 | 12.1具有自主学习和终身学习的意识 | 大学生职业生涯与发展规划、计算思维导论、科技革命与社会发展、遥感应用前景、现代测绘技术应用等。 |
| 12.2具有不断学习和适应发展的能力 | 智慧城市导论、遥感应用前景、新型航空遥感数据处理技术、深度学习与模式识别概论、毕业设计、遥感科学与技术创新实践及科研训练等。 |

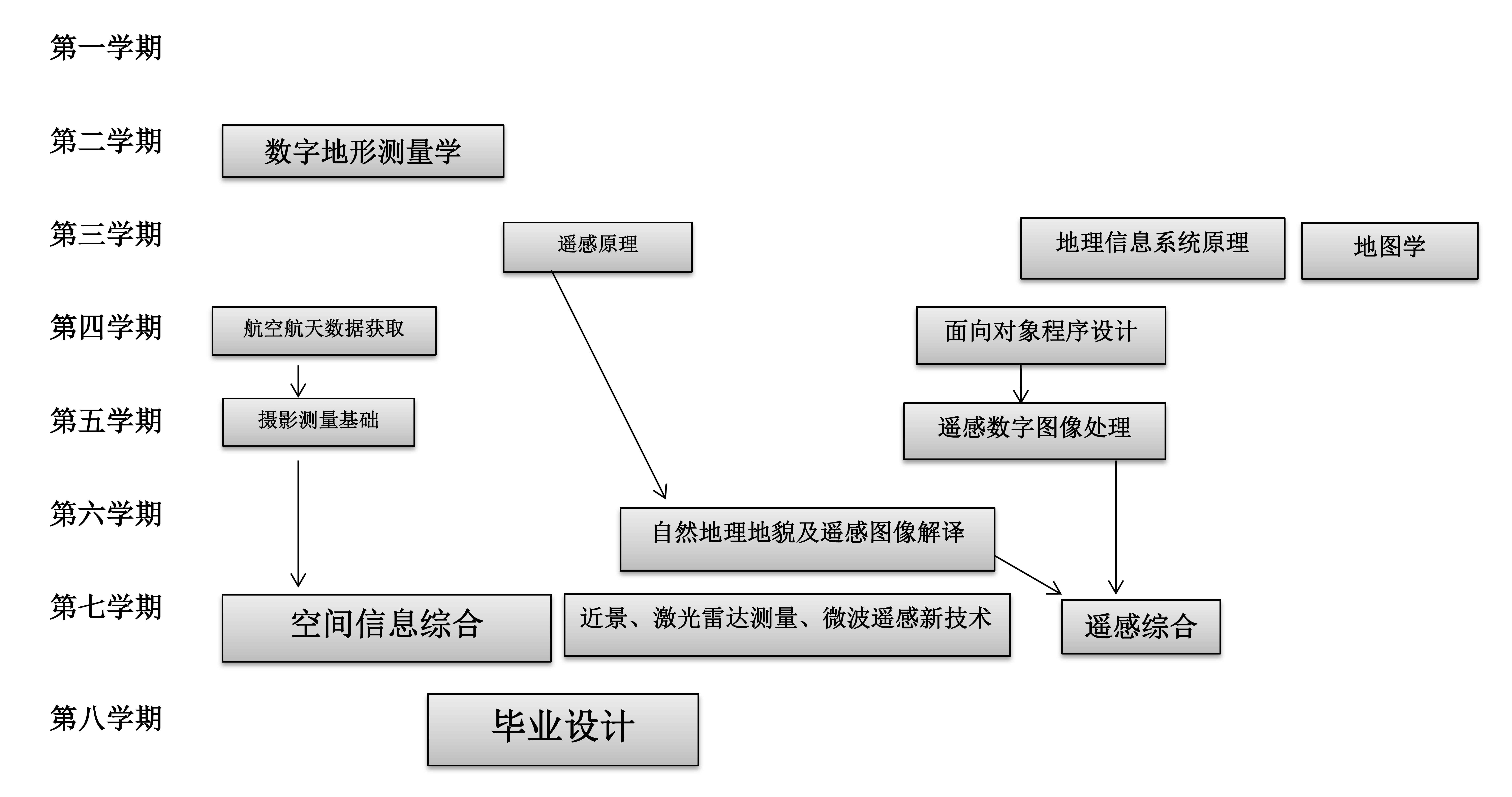
**十、指导性教学计划**（见附表）

**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

2019 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**

Science and Technology of Surveying and Mapping

IV. **Major Courses**

1. Basic Courses

Introduction to Geomatics, Digital Topographic Surveying, C Language and Data Structure, Physical Geography,, Cartography

2. Specialty Courses

Principles of Remote Sensing (Bilingual), Aerospace Data Acquisition, Photogrammetry Fundamental, Remote Sensing Digital Image Processing, Urban Remote Sensing, Digital Photogrammetry

**V. Major Practical Training**

Digital Topographic Surveying Practice, Photogrammetry Fundamental Practice, Aviation Data Acquisition, Field Work Practice of Aerial Photogrammetry Control And Annotation, 4D Products Integrated Photogrammetry Practice, Practice of Principles of Remote Sensing, Remote Sensing Digital Image Processing, Remote Sensing Comprehensive Practice, Natural Geography and Remote Sensing Image Interpretation Practice, (Close Range and Laser Radar, Mobile Measurement, Microwave Remote Sensing) New Technology Comprehensive Practice, The Principle of Geographic Information System, Graduation Project.

**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 165, including 126 credits of theoretical courses and 39 credits of practice teaching.

**VII. Proportion of Course**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course** [**Category**](http://www.baidu.com/link?url=T-sTAae63xKETLJd_N7nNsFUo4ds7VX1E0PW1OwBIazAjp1vVAUKLUIUFYxDzfyxsSDXgWReQf8aH7q_CabOr9251wtvAH6OwY8dszrOr2u) | **Course Type** | **Credits** | **Class Hour** | **Proportion** |
| General Education | Compulsory | 40.5 | 608 | 24.5 |
| Optional | 3.0 | 48 | 2 |
| Big Academic Subjects | Compulsory | 46 | 764 | 28 |
| Optional | 1 | 16 | 0.4 |
| Professional Core | Compulsory | 14 | 224 | 8.4 |
| Professional Direction | Compulsory | 11 | 176 | 6.7 |
| Optional | 10.5 | 168 | 6.4 |
| Practice | Compulsory | 39 | 780 | 23.6 |
| total |  | 165 | 2784 | 100 |
|  | |  |  |  |

**VIII. Table of Teaching Program**

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

**IX. Table of Teaching Arrangement**

X. **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 and data structure, 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 sensing | Physical experiment (1-2), close range photogrammetry, application of remote sensing technology, basic practice of photogrammetry, comprehensive practice of spatial information, graduation design, etc. |
| **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, and consider social, health, safety, legal, cultural and environmental factors. | 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 meet specific remote sensing needs | Remote sensing software, remote sensing technology application, GIS software use, object-oriented programming, remote sensing 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 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. | 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 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 implementation, and understand the responsibilities to be undertaken | 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 |
| **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 geographic information industry in the practice of remote sensing engineering, and fulfill their responsibilities. | 8.1 have the quality of Humanities and Social Sciences, establish correct world outlook, outlook on life and values, | Ideological and moral cultivation and legal basis, 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 |
| 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 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 decision-making methods, and be able to apply them in a multidisciplinary environment. | 11.1 master the management and economic decision-making methods involved in engineering projects | Digital topographic survey, 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 sensing and mapping production, and understand the engineering management and economic decision-making issues involved in it | Modern surveying and mapping technology application, aerospace data acquisition 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**  **学**  **时** | **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 | 32 |  |  | 16 |  | 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 | 32 |  |  | 16 |  | 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 | 48 |  |  | 32 |  | 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 |
| 大学英语(1-2) ★ English(1-2) | 6 | 128 | 96 |  |  |  | 32 | 1-2 | 文法学院 |
| 大学英语拓展系列课程（1-4）  College English training（1-4） | 2 | 32 | 32 |  |  |  |  | 3 | 文法学院 |
| 大学英语拓展系列课程（5-8）  College English training（5-8） | 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 | 32.5 | 640 | 480 |  |  | 128 | 32 |  |  |
| 核心 | 经典赏析与文化传承 | 2 | 32 |  |  |  |  |  | 1-8 | 各院部 |
| 哲学视野与文明对话 | 2 | 32 |  |  |  |  |  | 1-8 | 各院部 |
| 科技革命与社会发展 | 2 | 32 |  |  |  |  |  | 1-8 | 各院部 |
| 建筑艺术与审美教育 | 2 | 32 |  |  |  |  |  | 1-8 | 各院部 |
| 生态文明与未来城市 | 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 | | | | | | | | | |
| 选修 | 创新创业类 | 1-8学期任选 | | | | | | | | 各院部 |
| 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3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32.5学分，通识教育核心8学分，通识教育任选3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 | 80 | 80 |  |  |  | 16 | 1 | 理学院 |
| 高等数学A（2）★  Advanced Mathematics A(2) | 5 | 80 | 80 |  |  |  |  | 2 | 理学院 |
| 线性代数  Linear Algebra | 2 | 32 | 32 |  |  |  | 8 | 2 | 理学院 |
| 概率与数理统计B  Theory of Probability and Statistics (B) | 3 | 44 | 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 |
| 工程制图与识图 Engineering Drawing and Interpreting | 3 | 44 | 44 |  |  |  | 4 | 2 | 理学院 |
| C语言与数据结构 ★ C Programming Language and Data Structure | 3 | 48 | 32 | 16 |  |  |  | 1 | 地理信息科学系 |
| 自然地理学Physical geography | 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 Principles of Remote Sensing | 2 | 32 | 32 |  |  |  |  | 3 | 遥感工程系 |
| **小 计** | **46** | **764** | **644** | **120** |  | **8** | **32** |  |  |
| 选  修 | 现代测绘技术应用  Application of Modern Surveying and Mapping Technology | 1 | 16 | 8 | 8 |  |  |  | 2 | 测绘工程系 |
| GIS基础应用技能GIS base Application Skill | 1 | 16 | 8 | 8 |  |  |  |  | 地理信息科学系 |
| 遥感应用前景Remote Sensing Application Prospect | 1 | 16 | 8 | 8 |  |  |  | 3 | 遥感工程系 |
| **小 计** | **3** | **48** | **24** | **24** |  |  |  |  |  |
| **大类学科基础课合计 47学分，必修46 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 |
| 摄影测量基础Photogrammetry Fundamental | 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 |
| 数字摄影测量Digital Photogrammetry | 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 | | | | | | | | | | |
| 专  业  方  向  课 | 必  修 | 卫星导航定位技术Technology of Satellite navigation and positioning | 2 | 32 | 28 | 4 |  |  |  | 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（seminar） | 2 | 32 | 16 | 16 |  |  |  | 6 | 遥感工程系 |
|  | **小 计** | **11** | **176** | 100 | 28 |  |  |  |  |  |
| 选  修 | 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 |
| 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 |
| 大地测量基础Geodesy Fundamental | 2 | 32 | 24 | 8 |  |  |  | 4 | 测绘工程系 |
| 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 |
| 深度学习与模式识别概论 An introduction to deep learning and pattern recognition | 1 | 16 | 16 |  |  |  |  | 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 |
|  | **小 计** | **21** | **336** | **258** | **78** |  |  |  |  |  |
| **专业方向合计21.5 学分，必修11 学分，选修 10.5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 | | 1 | 32 | 32 |  | 1 | 1-3 | 武装部 |
| 军训  Military Training | | 1 | 32 | 32 |  |
| 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 |
| 摄影测量基础实习Photogrammetry Fundamental Practice | | 1 | 20 | 20 |  | 5 | 19 | 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 |
| 航空航天数据获取Aerospace data Acquisition Practice | | 1 | 20 | 20 |  | 4 | 18 | 遥感工程系 |
| 空间信息综合实习Spatial Information Practice | | 6 | 120 | 120 |  | 7 | 1-6 | 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 |
| 遥感原理实习Principles and Applications of Remote Sensing Practice | | 1 | 20 | 20 |  | 4 | 17 | 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 | | 2 | 40 | 40 |  | 6 | 16-17 | 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、地理信息科学系 |
| 面向对象程序设计实习Object oriented programming Practice | | 2 | 40 | 40 |  | 4 | 19-20 | 地理信息科学系 |
| 毕业设计Undergraduate Design or Thesis | | 8 | 320 | 320 |  | 8 | 1-16 | 遥感工程系 |
| **小 计** | | **37** | **920** | **920** |  |  |  |  |
| 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 |
| 则泰杯全国论文大赛 Mostrule Cup-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） | | | | | | | | | |