《遥感原理与数字图像处理》课程教学大纲（2020 版）

<table>
<tr><th colspan="6">课程基本信息（Course Information）</th></tr>
<tr><td>课程代码
(Course Code)</td><td>MS3804</td><td>*学时
(Credit Hours)</td><td>48</td><td>*学分
(Credits)</td><td>3</td></tr>
<tr><td rowspan="2">*课程名称
(Course Name)</td><td colspan="5">（中文）遥感原理与数字图像处理</td></tr>
<tr><td colspan="5">（英文）Remote Sensing Principles and Digital Image Processing</td></tr>
<tr><td>课程类型
(Course Type)</td><td colspan="5">专业选修课
Elective Course</td></tr>
<tr><td>授课对象
(Target Audience)</td><td colspan="5">本科生
Undergraduate student</td></tr>
<tr><td>授课语言
(Language of Instruction)</td><td colspan="5">双语
Chinese and English</td></tr>
<tr><td>*开课院系
(School)</td><td colspan="5">海洋学院
School of Oceanography</td></tr>
<tr><td>先修课程
(Prerequisite)</td><td>高等数学、线性代数、大学物理
Higher mathematics, Linear algebra, General physics</td><td>后续课程
(post)</td><td colspan="3"></td></tr>
<tr><td>*课程负责人
(Instructor)</td><td>王显威</td><td>课程网址
(Course Webpage)</td><td colspan="3"></td></tr>
<tr><td>*课程简介
（中文）
(Description)</td><td colspan="5">课程性质：
本课程是针对海洋科学专业本科生开设的专业选修课；

教学内容：
本课程重点介绍卫星遥感发展历史及技术进步趋势、卫星遥感的基本原理（主要包括辐射传输理论、光学遥感、近红外遥感、合成孔径雷达、雷达高度计、激光高度计、机载遥感、地基遥感测量原理等）、全球定位系统、北斗测量原理、多源遥感图像处理技术等；利用多源遥感数据反演海洋表面观测量（如温度、有效波高等）方法；地图投影以及专题图制作；遥感在海洋变化、海-陆交接地带监测、极地变化监测中的应用等；

教学目标：
通过该课程的教授，使学生比较系统地掌握星载遥感探测地物原理（光学、近红外、微波、合成孔径雷达遥感、高度计以及激光雷达等）、遥感观测过程的影响因素、全球定位系统、北斗测量的基本原理；掌握多源遥感数据融合、图像分类、图像增强等数字图像处理的基本方法；掌握地图投影选择以及专题图制作方法；掌握部分机载或者地基遥感观测手段；</td></tr>
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	了解多源遥感在全球变化、海洋变化监测、极地变化研究中的最新进展； 了解和掌握一些与遥感、全球定位系统相关的基本的英文词汇；
*课程简介（英文）(Description)	**Course Type** This is an elective course setting for undergraduates majored in Ocean Science **Course Content** This course will primarily focus on the developing history and advancing trend of remote sensing, basic principles of satellite remote sensing (e.g., radiative transfer theory; Theories of Optical Remote Sensing, Near Infra-Red Remote Sensing, Synthetic Aperture Radar, Radar Altimeter, Laser Altimeter, Airborne Remote Sensing and Land-based Remote Sensing), basic theories of Global Positioning System and Beidou observation, image processing techniques of multi-source Remote Sensing data. It will also cover the introduction of inversion methods of some critical variables for ocean surface change study, such as sea surface temperature and significant wave height using remote sensing data. The map projection and method for thematic map production will be included. The application of remote sensing observations in global ocean changes, costal region change detection and polar change study will also be covered in this course. **Teaching Objective** After taking this course, the undergraduates would systematically master different spaceborne remote sensing theories (e.g. Optical, Near Infra-Red, Microwave, Synthetic Aperture Radar Remote Sensing, Altimetry and Lidar) of different land covers, the critical influence of different remote sensing progresses, basic principle of Global Positioning System, Beidou, some basic methods of digital image processing (e.g., image fusion, classification and strengthen techniques), map projection and thematic map production, as well as the theories of airborne and land-based remote sensing observations. They would also learn the applications of multi-source remote sensing observations in global change study, ocean monitoring and change detection study, polar change researches and the advancing trends of different remote sensing techniques. They would learn and master some basic terminologies related to remote sensing and Global Positioning System as well.
课程目标与内容（Course objectives and contents）	
*课程目标 (Course Object)	1. 了解卫星遥感发展的历史及趋势，熟悉国内外常用的遥感卫星，遥感系统的主要组成部分以及了解遥感在全球变化、海洋监测、极地变化中的应用； 2. 掌握电磁波谱频段，遥感窗口，光学、微波等遥感定义、遥感辐射传输过程； 3. 掌握可见光遥感基础，大气对光学遥感的影响，电磁波与地物作用特点，部分地物的光谱反射特性，光学遥感在海洋监测中的应用; 4. 掌握近红外遥感的原理及其在海洋表面温度反演中的应用，海洋水色遥感机理及其应用； 5. 掌握地图投影基本原理、常用地图投影类型、地图成图投影方式选择等； 6. 掌握遥感图像增强、图像融合、图像拼接、图像分类技术、海表温度提取算法等； 7. 掌握合成孔径雷达的原理、合成孔径雷达成像特性，了解雷达波与海面相互作用原理及其在海洋、极地变化研究中的应用；

	8. 掌握全球定位系统定位、北斗定位系统原理，了解全球定位系统、北斗定位系统的应用； 9. 掌握卫星高度计的基本原理、大地水准面与海平面的区别和高度计测波原理，了解星载雷达、激光高度计的主要应用等； 10. 掌握常用的机载、地基雷达、激光雷达等观测方式、原理以及应用； 11. 提高对遥感、全球定位系统、数字图像处理等先进技术的学习兴趣，增强海洋变化、全球变化、极地变化等方面的知识储备； 12. 培养善于思考，善于提问，勇于质疑的能力，课外主动阅读、自主学习的能力； 1. Learn the history and the advancing trend of Remote Sensing. Know some remote sensing satellites and missions as well as the components of Remote Sensing. Master some important applications of Remote Sensing in Global Change study, Ocean change monitoring and Polar Change researches. 2. Master the full spectrum of EM wave, some terminology of atmospheric window, optical and microwave Remote Sensing, and radiation transformation process. 3. Master principle of optical Remote Sensing, the atmospheric influence on optical Remote Sensing, how EM wave interacts with different land surface, spectral reflectance characteristics of typical land covers, application of optical remote sensing in ocean change study. 4. Master the principle of Near Infra-Red Remote Sensing, the application of NIR remote sensing in Sea Surface Temperature extraction, Ocean color remote sensing and its applications. 5. Master the principle of projection, know some important and widely used map projection and the proper choice of projection when making thematic map. 6. Master the method of image strengthen, image fusion, image mosaic, image classification and Sea Surface Temperature inversion using Remote Sensing. 7. Master the principle and image characteristic of SAR, how radar wave interacts with sea surface and the wide application of SAR in ocean and polar change study. 8. Master the principle and application of Global Positioning System and Beidou System. 9. Master the principle of spaceborne altimeters, some terminology of geoid and sea surface height, wave observation theory with radar altimeter, and applications of radar and laser altimeters. 10. Master the principles and application of airborne and land-based radar/lidar observation. 11. Inspire the learning interest of some applications of advanced techniques, such as remote sensing, GPS and digital image processing and enrich the knowledge storage of ocean change, global change and polar change study. 12. Develop the independent-thinking, question-raising and skeptical skills, cultivate self-motivated reading and self-learning capabilities.

*教学内容进度安排及对应课程目标	章节	教学内容（要点）	学时	教学形式	作业及考核要求	课程思政融入点	对应课程目标

(Class Schedule & Requirements & Course Objectives)	示例:						
	第一章	绪论与 遥感发展历史 (Introduction and History of Remote Sensing)	2	课堂教学 Class teaching	1 次 Once		1， 11，12
	第二章	电磁波与辐射传输理论 (Electro-Magnetic Wave and Radiation Transfer Theory)	3	课堂教学 Class teaching	1 次 Once		2， 11，12
	第三章	光学遥感原理与应用 (Theories and Applications of Optical Remote Sensing)	4	课堂教学 Class teaching	1 次 Once		3， 11，12
	第四章	红外遥感原理与应用 (Theories and Applications of Infra-Red Remote Sensing)	3	课堂教学 Class teaching	1 次 Once		4， 11，12
	第五章	地图投影与高程基准 (Map Projection and Elevation Reference)	4	课堂教学 Class teaching	1 次 Once		5， 11，12
	第六章	遥感图像处理 (Image Processing of Remote Sensing Data)	6	课堂教学 Class teaching	1 次 Once		6， 11，12
		遥感图像校正拼接（Georeferencing and Mosaic of Remote Sensing Images）	2	**实验教学** Experimental teaching	1 次 Once		6， 11，12
		遥感图像地物分类 (Classification of Remote Sensing Images)	2	**实验教学** Experimental teaching	1 次 Once		6， 11，12

	第七章	遥感图像处理 (Image Processing of Remote Sensing Data)	2	课堂教学 Class teaching	1 次 Once		6， 11，12
		海洋参数遥感提取与应用 (Remote Sensing and Applications of Ocean Physical Parameters)	2	**实验教学** Experimental teaching	1 次 Once		6， 11，12
	第八章	合成孔径雷达遥感与应用 (Theories and Applications of SAR)	4	课堂教学 Class teaching	1 次 Once		7， 11，12
		雷达图像识别与制图 (Image Recognition and Mapping of SAR Images)	2	**实验教学** Experimental teaching	1 次 Once		7， 11，12
	第九章	GPS 测量原理与应用 (Theories and Applications of GPS)	4	课堂教学 Class teaching	1 次 Once		8， 11，12
	第十章	激光/雷达高度计遥感与应用 (Theories and Applications of Radar, Laser Altimetry)	4	课堂教学 Class teaching	1 次 Once		9， 11，12
	第十一章	Lidar 与地基雷达遥感与应用 (Applications of Lidar and Land-based Radar)	2	课堂教学 Class teaching	1 次 Once		10， 11，12
		GPS、激光雷达测量及数据处理 (Lidar Observation and GPS Data Processing)	2	**实验教学** Experimental teaching	1 次 Once		10， 11，12

	注 1：建议按照教学周周学时编排。 注 2：相应章节的课程思政融入点根据实际情况填写。
*考核方式 (Grading)	出勤分数 10%、平时作业分数 20%，上级实习作业分数 20 %和期末考试成绩 50% Attendance for 10%, Assignments for 20%, Project Exercise for 20% and Final Examination for 50%
*教材或参考资料 (Textbooks & Other Materials)	（必含信息：教材名称，作者，出版社，出版年份，版次，书号） 1. 遥感应用分析原理与方法，赵英时等，科学出版社，2013 2. An introduction to ocean remote sensing, Seelye Martin, published in the United States of America by Cambridge University Press, New York, Second Edition, 2014 3. 海洋遥感基础及应用，潘德炉，海洋出版社， 2017 4. 海洋遥感导论，马丁，海洋出版社(修订版)， 2017 5. 海洋微波遥感与应用，潘德炉，林明森，毛志华，海洋出版社，2013 6. 遥感数字图像处理与分析 原理与方法，朱文泉 林文鹏，高等教育出版社，2015 7. GPS 测量原理及应用，徐绍铨，武汉大学出版社，2017
其它 (More)	
备注 (Notes)	