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**Course Name:** MAP DIGITIZATION

**Number of credits:** 4,5 ECTs

**Period:** Fall/spring semester

Coordinator	Faculty of Marine Resources and Management
Credits	4,5 ECTs
Lecturers	Le Thi Kim Thoa
Level	BSc.
Host institution	Ho Chi Minh City University of Natural Resources and Environment
Course duration	1 semester (the classes will be scheduled in accordance with the university timetable)
New/revised	revised course (35%)

### **Summary**

The course provides an in-depth understanding of the principles and techniques involved in digitizing maps. Students will learn how to convert paper maps into digital formats, work with GIS (Geographic Information System) software, and create accurate and visually appealing digital maps.

### **Target student audiences**

BSc. students majoring in hydrometeorology

### **Prerequisites**

Required courses (or equivalents): NO

### **Aims and objectives**

The main course objective is to equip students with knowledge of:

- Tools use for digital mapping
- Equipped with knowledge about geographic information systems and specialized map digitalization.
- Process of obtaining databases from remote sensing imageries.
- Process of converting paper maps into digital maps
- Process of building maps from field data collection

### **The Authentic Tasks:**

The course provides basic knowledge of modeling pollutant transmission processes in marine environments.

### **General learning outcomes:**

By the end of the course, successful students will:



Knowledge	<ul style="list-style-type: none"> <li>• Understanding the fundamentals of map digitization and the importance of digital mapping in various application.</li> <li>• Collect, organize and clean geographic data for digitization</li> <li>• Digitize map features using GIS software</li> </ul>
Comprehensive	<ul style="list-style-type: none"> <li>• Perform spatial analysis and geoprocessing tasks on digitized data</li> </ul>
Application	<ul style="list-style-type: none"> <li>• Design and create visually appealing digital maps</li> </ul>
Analysis	<ul style="list-style-type: none"> <li>• Interpret and document map metadata.</li> </ul>
Synthesis	<ul style="list-style-type: none"> <li>• Apply digitization skills to real world mapping projects</li> </ul>

### Overview of sessions and teaching methods

The course will make most of interactive and self-reflective methods of teaching and learning and, where possible, avoid standing lectures and presentations.

- Learning methods**
- Lecture note presentations
  - Practical exercises
  - Final project
  - Class participation
  - Team work
  - Project- based learning

### Course outline

Week	Topics
Week 1	Introduction to map digitization
Week 2	Overview of GIS and its applications
Week 3	GIS software and data structures
Week 4	Get familiar with GIS software and Building a database
Week 5	Digitizing maps from field data collection
Week 6	Digitizing maps from remote sensing images
Week 7	Digitizing manual paper maps
Week 8	Automatic digitization of paper maps
Week 9	Editing digital maps
Week 10	Merging adjacent digitizing maps and map editor

### Course Schedule

<b>Topic 1 - Introduction to the map digitization (10% revised)</b>	
Learning objectives	<ul style="list-style-type: none"> <li>• Overview of maps, digital maps</li> <li>• What is map digitization?</li> <li>• Benefits of map digitization</li> </ul>



	<ul style="list-style-type: none"> <li>• Classification of digital map database</li> <li>• Map digitization techniques</li> <li>• Map digitization process</li> </ul>
Learning outcomes	<ul style="list-style-type: none"> <li>• Understanding the fundamentals of map digitization and the importance of digital mapping</li> </ul>
Student deliverables	<ul style="list-style-type: none"> <li>• Exercise: individual assignments</li> </ul>
Topic materials	Lecture: Lecture of map digitization
<b>Outline</b>	<ul style="list-style-type: none"> <li>- Overview of maps, digital maps</li> <li>- What is map digitization?</li> <li>- Benefits of map digitization</li> <li>- Classification of digital map database</li> <li>- Map digitization techniques</li> <li>- Map digitization process</li> </ul>
<b>Topic 2- Overview of GIS and its applications ( 15% revised)</b>	
Learning objectives	<ul style="list-style-type: none"> <li>• Familiar with different types of GIS products available.</li> <li>• Understanding the data structure of GIS</li> </ul>
Learning outcomes	<ul style="list-style-type: none"> <li>• Distinguish different types of GIS products available</li> <li>• Demonstrate the data structure of GIS</li> </ul>
Student deliverables	<ul style="list-style-type: none"> <li>• Exercise: learn about GIS software packages and their strengths for specific purposes.</li> </ul>
Topic materials	<ul style="list-style-type: none"> <li>• Lecture of map digitization</li> </ul>
Outline	<ul style="list-style-type: none"> <li>- Some commercial GIS software</li> <li>- Some opensource GIS software</li> <li>- Introduction to ARCGIS Desktop</li> <li>- Standard database format of ARCGIS</li> </ul>
<b>Topic 3 - Some GIS software, content and data structure of GIS database (20% revised)</b>	
Learning objectives	<ul style="list-style-type: none"> <li>• Familiar with different types of GIS products available.</li> <li>• Understanding the data structure of GIS</li> </ul>
Learning outcomes	<ul style="list-style-type: none"> <li>• Distinguish different types of GIS products available</li> <li>• Demonstrate the data structure of GIS</li> </ul>
Student deliverables	<ul style="list-style-type: none"> <li>• Exercise: learn about GIS software packages and their strengths for specific purposes.</li> </ul>
Topic materials	<ul style="list-style-type: none"> <li>• Lecture of map digitization</li> </ul>
Outline	<ul style="list-style-type: none"> <li>- Some commercial GIS software</li> <li>- Some opensource GIS software</li> <li>- Introduction to ARCGIS Desktop</li> <li>- Standard database format of ARCGIS</li> </ul>
<b>Topic 4 - Get familiar with the ARCGIS interface (15% revised)</b>	



Learning objectives	<ul style="list-style-type: none"> <li>• Get familiar with the ARCGIS interface</li> <li>• Some basic display functions in ArcMap</li> <li>• Get familiar with ARCMAP with Ho Chi Minh database</li> </ul>
Learning outcomes	<ul style="list-style-type: none"> <li>• Open and perform basic operations on a map to work with the given geographic data to create a map.</li> <li>• Understand geographic data (organization, spatial representation, attributes)</li> </ul>
Student deliverables	<ul style="list-style-type: none"> <li>• Exercise: practice in class and homework</li> </ul>
Topic materials	<ul style="list-style-type: none"> <li>• Lecture of map digitization</li> </ul>
Outline	<ul style="list-style-type: none"> <li>- Get familiar with the ARCGIS interface</li> <li>- Some basic display functions in ArcMap</li> <li>- Practice in class with Ho Chi Minh database</li> </ul>
<b>Topic 5: Building geodatabase (15% revised)</b>	
Learning objectives	<ul style="list-style-type: none"> <li>• Understand what is geodatabase and how to create a geodatabase</li> <li>• Create data into geodatabase</li> <li>• Import data into geodatabase</li> </ul>
Learning outcomes	<ul style="list-style-type: none"> <li>• Understanding the role of geodatabase.</li> <li>• Able to create a geodatabase and import data into geodatabase.</li> </ul>
Student deliverables	<ul style="list-style-type: none"> <li>• Exercise: practice in class and homework</li> </ul>
Topic materials	<ul style="list-style-type: none"> <li>• Lecture of map digitization</li> </ul>
Outline	<ul style="list-style-type: none"> <li>- Geodatabase definition, the role of geodatabase</li> <li>- Create a geodatabase</li> <li>- Input data into geodatabase</li> <li>- Import data into geodatabase</li> </ul>
<b>Topic 6- Digitizing maps from field data collection (35% revised)</b>	
Learning objectives	<ul style="list-style-type: none"> <li>• Understand the process of data collection, data entry, data quality control and data mapping</li> </ul>
Learning outcomes	<ul style="list-style-type: none"> <li>• Able to perform the tasks of mapping data from the GIS sources</li> </ul>
Student deliverables	<ul style="list-style-type: none"> <li>• Exercise: practice in class and homework</li> </ul>
Topic materials	Lecture of map digitization
Outline	<ul style="list-style-type: none"> <li>- Digitize point data</li> <li>- Digitize line data</li> <li>- Digitize regional data</li> </ul>
<b>Topic 7- Digitizing maps from satellite images (35 % revised)</b>	
Learning objectives	<ul style="list-style-type: none"> <li>• Understand the process of data collection, data entry, data registration and data mapping</li> </ul>



Learning outcomes	<ul style="list-style-type: none"> <li>• Able to perform the tasks of mapping data from remotely sensed data</li> </ul>
Student deliverables	<ul style="list-style-type: none"> <li>• Exercise: practice in class and homework</li> </ul>
Topic materials	Lecture of map digitization
Outline	<ul style="list-style-type: none"> <li>- Digitizing satellite images taken from Google Earth (no coordinates)</li> <li>- Digitize satellite images downloaded from the United States Geological Service - USGS website</li> <li>- Digitize satellite images from Google Map</li> <li>- Digitize satellite images from google Earth Pro</li> </ul>
<b>Topic 8- Digitizing manual paper maps (30 % revised)</b>	
Learning objectives	<ul style="list-style-type: none"> <li>• Impart specific skills and knowledge related to the process of digitizing manual paper maps</li> </ul>
Learning outcomes	<ul style="list-style-type: none"> <li>• Understanding the basics of map digitizing</li> <li>• Utilise various data collection methods</li> <li>• Operating GIS software to convert paper maps into digital formats.</li> <li>• Understand the coordinate system and projection</li> </ul>
Student deliverables	<ul style="list-style-type: none"> <li>• Exercise: practice in class and homework</li> </ul>
Topic materials	<ul style="list-style-type: none"> <li>• Lecture of map digitization</li> </ul>
Outline	<ul style="list-style-type: none"> <li>- Scan the map</li> <li>- Set the coordinate system for the map</li> <li>- Digitize the map</li> <li>- Correct digitization errors</li> <li>- Enter attribute database</li> <li>- Map editor</li> </ul>
<b>Topic 9- Automatic digitization of paper maps (100% updated)</b>	
Learning objectives	<ul style="list-style-type: none"> <li>• gaining specific skills and knowledge related to the process of automatic digitizing paper maps</li> </ul>
Learning outcomes	<ul style="list-style-type: none"> <li>• Understanding automatic digitization</li> <li>• Understanding the georeferencing process and its significance in aligning digital maps with geographic coordinates.</li> <li>• Able to convert detected maps features from raster format into vector format using automatic methods.</li> </ul>
Student deliverables	<ul style="list-style-type: none"> <li>• Exercise: practice in class and homework</li> </ul>
Topic materials	<ul style="list-style-type: none"> <li>• Lecture of map digitization</li> </ul>
Outline	<ul style="list-style-type: none"> <li>- Scan the map</li> <li>- Read scanned map information, set up digital database structure</li> </ul>



	<ul style="list-style-type: none"> <li>- Set up the digitized map coordinate system</li> <li>- Automatic map digitization</li> <li>- Correct digitization errors</li> <li>- Input attribute data</li> </ul>
<b>Topic 10- Editing digital maps (40% revised)</b>	
Learning objectives	<ul style="list-style-type: none"> <li>• Equipping students with skills and knowledge needed to effectively edit digital maps.</li> </ul>
Learning outcomes	<ul style="list-style-type: none"> <li>• Ability to manage and edit various data layers</li> <li>• Proficiency in editing map data, including adding, modifying, deleting map features with accuracy and precision.</li> </ul>
Student deliverables	<ul style="list-style-type: none"> <li>• Exercise: practice in class and homework</li> </ul>
Topic materials	<ul style="list-style-type: none"> <li>• Lecture of map digitization</li> </ul>
Outline	<ul style="list-style-type: none"> <li>- Common errors in automatic map digitization</li> <li>- Correct digitization errors</li> <li>- Link attribute data to digital maps</li> </ul>

## Literature

### Compulsory

[1]. Lecture of map digitization.

### Recommended:

[2]. Le Thi Minh Phuong (2018) Geographic information system in urban management, Construction Publishing House, Hanoi.

[3]. Le Thi Minh Phuong (2019) Maps and Geographic Information System, Construction Publishing House, Hanoi.

[4]. Le Thi Giang and others (2021) Geographic information system textbook, Academy of Agriculture Publishing House.

[5]. Tran Vinh Phuoc (2003) General GIS - theoretical part, Ho Chi Minh City National University Publishing House, Ho Chi Minh City.

[6]. Nguyen Kim Loi, Tran Thong Nhat (2008) Geographic information system, Publishing House. Agriculture, Ho Chi Minh City.

[7]. Dang Van Duc (2001) Geographic Information System, Hanoi Science and Technology Publishing House, Hanoi.

[8]. Tran Trong Duc (2010) Basic GIS, Publishing House. City National University. Ho Chi Minh City, Ho Chi Minh City.

[9]. Tor Bernhardsen (2002) Geographic Information Systems – An Introduction, 3rd edition, John Wiley & Son.

[10]. Jochen Albrecht (2007) Concepts and techniques in GIS, Sage.

[11]. Paul Longley, Michael Goodchild, David Maguire, David Rhind (2004) Geographic Information and Science, 2nd edition, John Wiley & Son.



[12]. Rolf A. de By et al. (2001) Principles of geographic information systems – An introductory textbook, ITC, Netherland.

### Course workload

The table below summarizes course workload distribution:

Activities	Learning outcomes	Assessment	Estimated workload (hours)
<b>In-class activities (45 hours)</b>			
Lectures ( 2 hours/ week)	Attending online course, discussions, and demonstrations related to mapping digitization concepts, techniques and tools.	Class participation	15
Moderated in-class discussions ( 1 hour/ week)	Actively engaging in class discussions, asking questions, and contributing to the learning environment.	Class participation and preparedness for discussions	10
In-class assignments, homework assignment (1 hours/ week)	Practical exercises and labs	Class participation and preparedness for assignments	10
Reading and discussion of assigned papers for preparation for lectures	Reading course materials, textbooks, research papers, and relevant resources to gain a deeper understanding of mapping digitization concepts.	Class participation, creative and active contribution to discussion	10
<b>Independent work (90 hours)</b>			
Home work and Exercise	Ability to interpret data, analyze objects and use concepts, tools, and methods, and equations to solve problems.	Quality of individual assignments	90
<b>Total</b>			<b>135</b>

### Course Assignments

Course assignments will constitute a multi-part project:

- Assignment #1 -(in-class): Working in group and preparing about GIS software packages and their strengths for mapping digitization.
- Assignment #2 - (home work): manual digitization of paper map
- Assignment #3 –(home work): automatic digitization of paper map
- Assignment #4 (home work): Digitizing maps from satellite images
- Assignment #5 (home work): Digitizing maps from GIS sources



## Grading

The students' performance will be based on the following:

<b>Assessment</b>	<ul style="list-style-type: none"><li>• Progress assessment (40%):<ul style="list-style-type: none"><li>- practice in class (15%):</li><li>- Homework (25%):</li></ul></li><li>• Final assessment (60%):<ul style="list-style-type: none"><li>- Semi- Final examination (10%)</li><li>- Final examination (50%)</li></ul></li></ul>
<b>Evaluation</b>	A (8,5 – 10) B (7,0 – 8,4) C (5,5 - 6,9) D (4,0 – 5,4)