Course Syllabus

Geographic Information Systems

March – July 2025

Term VI Semester

Lecturer

Estrada Mendoza, Miguel

I. General Course Information

Subject:	Geographic Information System		
Pre-requisite:	None	**Code:**	10345
Precedent:	None	**Semester:**	2025-I
Credits:	3	**Term:**	VI
Weekly Hours:	4	**Course Type:**	Class – based
Type Program	Environmental Management Engineering	**Course Coordinator:**	Miguel Estrada mestrada@esan.edu.pe

II. Summary

This course provides an in-depth introduction to the fundamental concepts and techniques of Geographic Information Systems (GIS). Students will learn how to use GIS software to create, manage, analyze, and visualize spatial data. The course will equip students with the knowledge and skills necessary to analyze and apply spatial information in the planning and management of natural resources.

Through hands-on exercises and real-world examples, students will gain practical experience in using GIS software and tools to solve real-world problems. By the end of the course, students will have a solid understanding of the principles of GIS and be able to apply them to a wide range of applications in natural resource management and other fields.

III. Course Objectives

The main objective of this course is to provide students with a comprehensive understanding of Geographic Information Systems (GIS) and its applications in natural resource management. By the end of the course, students will be able to use GIS software to create, manage, analyze, and visualize spatial data. In addition, students will gain an understanding of the ethical and legal issues related to GIS data and its use. Overall, this course aims to equip students with the knowledge and skills necessary to apply GIS to a wide range of applications in natural resource management and other fields.

IV. Learning Results

Learning Outcomes are based on a methodology of critical thinking progression which starts with basic activities that build a foundation of knowledge and skills, and gradually progresses to more advanced, critical thinking tasks that require students to apply their knowledge and skills to solve complex problems. By starting with basic activities and gradually building up to more advanced tasks, students are able to develop a deep understanding of GIS concepts and techniques and are better equipped to apply critical thinking skills to real-world problems. This approach also helps students to develop a sense of confidence and competence in their ability to use GIS to solve complex problems.

By the end of the course students will be able to:

- Identify and describe basic GIS concepts and terminology.
- Use GIS software to create and edit spatial data.
- Analyze spatial data using basic GIS tools and techniques.
- Evaluate the quality and accuracy of spatial data.
- Interpret and analyze spatial data using advanced GIS tools and techniques.
- Synthesize spatial data from multiple sources to solve complex problems.
- Evaluate the effectiveness of different GIS methods and techniques.
- Develop and implement a GIS project plan.
- Apply critical thinking skills to analyze and solve real-world problems using GIS.
- Evaluate the ethical and legal implications of GIS data and its use.
- Communicate GIS results effectively through written and oral presentations.
- Collaborate effectively with others in a GIS project team.
- Apply GIS to a wide range of applications in natural resource management and other fields.
- Develop a deep understanding of the role of GIS in society and its potential impact on the environment and society.

V. Methodology

The course methodology emphasizes active student participation with the Lecturer assuming the role of learning facilitator. The course is designed to help students achieve the learning outcomes by providing a series of lectures and computer-based practical sessions using Quantum GIS (QGIS) software.

The computer-based practical sessions will be sequential and supported by video tutorials, which will be available via the course YouTube channel. These practical sessions are designed to provide students with hands-on experience using the software, while simultaneously illustrating and reinforcing theoretical concepts. Students will complete a series of practical assignments that are designed to provide experience with the software and reinforce the theoretical concepts covered in the lectures. These assignments are designed to help students achieve the learning outcomes by applying critical thinking skills to real-world problems using GIS.

Contact and communication between the student and lecturer will be via the virtual campus platform, where all the course resources will also be available.

It is strongly recommended that the student read the texts indicated in the bibliography and recommended weekly reading, as well as material that will be made available to encourage students to explore topics in greater depth. By following this methodology, students will be able to achieve the learning outcomes and develop a deep understanding of GIS concepts and techniques.

VI. Evaluation

The evaluation system is comprehensive and continuous with the objective of promoting learning in the student. The final grade is composed of Continuous Evaluation (CEA) (70%), Mid-Term exam (10%) and Final exam (20%).

The Average Permanent Evaluation is calculated based on the student's learning process follow up: Reading Controls/ Quizzes / Cases/ Presentations / Research Work / Class Contribution. The weighted average of these marks results in the corresponding score.:

AVERAGE PERMANENT EVALUATION 70%			
Type of evaluation	**Description**	**Weight %**	
Basic GIS mapping activities	4 basic mapping activities	20	
Assessed GIS Activities	2 timed assessments	25	25
Final project	Environmental problem-solving using GIS	30	

The final average grade (FA) is obtained as follows:

FA = (0,10 x MTE) + (0,70 x CEA) + (0,20 x FE)

Where:

FA = Final Average
MTE = Mid-Term Exam
CEA = Continuous Evaluation Average
FE = Final Exam

VII. Programmed content

Week	Contents	Activities / Evaluation
UNIT OF LEARNING I: Communication and Geographic Understanding • Understand the fundamental concepts of Geographic Information Science and Technology Demonstrate basic level proficiency in the creation of spatial data. • Select and combine appropriate visual variables to clearly represent geospatial data and • communicate map content.		
1st From March 17 to 21	**Introduction to Geographic Information Systems (GIS) & Spatial Thinking** 1.1 The Geospatial Revolution 1.2 The Changing Nature of Place 1.3 Geospatial Enquiry 1.4 GIS in Action Video Activity: https://youtu.be/poMGRbfgp38 Read Chapter 1 of Bolstad, Paul (2016). GIS Fundamentals: A first text on geographic information systems, 4th edition.	Presentation of the syllabus in all contents. Presentation of the course methodology. Revision of the guide (guidelines) for the development of the commissioned work (Includes explanation of the evaluation instrument) Revision of the Guide for the presentation of written work at ESAN University (APA standards). Spatial knowledge Quiz Week 1 Quiz QGIS Practical I
2nd From March 24 to 28	**Geodesy, Map Projections and Coordinate Systems** 2.1 Historical Cartography 2.2 Scale and Time 2.3 Coordinate Systems 2.4 Latitude and Longitude 2.5 Map Projections Video Activity: https://youtu.be/nMrhuKoE3cI Read Chapter 1 of Sobel, D & Andrewes, WJH (1998). The Illustrated Longitude: The True Story of the Lone Genius Who Solved the Greatest Scientific Problem of His Time. Read: Chapters 2 & 3 of Bolstad, Paul (2016). GIS Fundamentals: A first text on geographic information systems, 4th edition.	QGIS Practical II Week 2 Quiz Evaluation AAAI No 1

3rd From March 31 to April 04	**Cartography and Visualization I** 3.1 GIS and maps 3.2 Data acquisition 3.3 Map characteristics 3.4 Map design and production 3.5 Data Classification Video Activity: https://youtu.be/CWM1fftxxdg https://youtu.be/TUTmg1iVX8E Read Chapters 1, 2, 3, & 5 of Kraak, MJ & Ormeling, F (2010). Cartography: Visualization of Geospatial Data.	QGIS Practical III Week 3 Quiz Evaluation AAAI No 2
4th From April 07 to 11	**Cartography and Visualization II** 4.1 Creative Inspiration 4.2 Layout design 4.3 Fonts 4.4 Colours 4.5 Features Read: Chapters 2, 3, 4 & 5 of Peterson, G (2015). GIS Cartography: A Guide to Effective Map Design. Second Edition.	QGIS Practical IV Week 4 Quiz Evaluation AAAI No 3
UNIT OF LEARNING II: Principles of GI and Cartography. Part II provides students with the opportunity to acquire the skills and techniques required to become proficient GIS professionals. • Analyze the fundamentals of GIS data storage and interoperability and remote sensing. • Evaluate and apply different types of geospatial analysis techniques. • Construct datasets for use in geo-analysis. • Execute the results of a geospatial analysis using appropriate models, terminology, and visualizations.		

5th From April 14 to 18	**Geospatial Analysis I** Vector Operations, Single Layer Analysis, Multiple Layer Analysis 5.1 Introduction – Input, Operations, and Output 5.2 Selection and Classification 5.3 Dissolve 5.4 Proximity Functions and Buffering 5.5 Overlay 5.6 Network Analysis Read: Chapter 9 of Bolstad, Paul (2016). GIS Fundamentals: A first text on geographic information systems, 4th edition.	QGIS Practical V Week 5 Quiz Evaluation AAAI No 4

6th From April 21 to 25	**Geospatial Analysis II** Raster data: Basic Geoprocessing with Rasters 6.1 Map Algebra 6.2 Local Functions 6.3 Neighborhood, Zonal and Global Functions 6.4 Introduction to Terrain Analysis Read: Chapter 10 of Bolstad, Paul (2016). GIS Fundamentals: A first text on geographic information systems, 4th edition.	QGIS Practical VI Week 6 Quiz
7th From April 28 to May 02	**Geospatial Analysis III** 7.1 Introduction to Terrain Analysis 7.2 Spatial Estimation and Interpolation 7.3 Cartographic Modelling Read: Chapter 11 of Bolstad, Paul (2016). GIS Fundamentals: A first text on geographic information systems, 4th edition.	QGIS Practical VII Week 7 Quiz
8th From May 05 to 09	**Mid Term Exam**	
9th From May 12 to 16	**Geospatial Data Acquisition & Management** 9.1 Geographic Data Acquisition 9.2 Geospatial Database Management 9.3 File Formats 9.4 Data Quality Read: Chapter 2 of Kraak, MJ & Ormeling, F (2010). Cartography: Visualization of Geospatial Data Read: Chapter 4 of Bolstad, Paul (2016). GIS Fundamentals: A first text on geographic information systems, 4th edition.	QGIS Practical VIII Week 9 Quiz

10th From May 19 to 23	**Introduction to Remote Sensing I** 10.1 History and Scope of Remote Sensing 10.2 Electromagnetic radiation 10.3 Mapping Cameras, Digital Imagery and Image Interpretation 10.4 Earth Observation Satellites Read: Chapters 1 & 2 of Campbell (2011) Introduction to Remote Sensing.	SNAP Practical I QGIS Practical IX Week 10 Quiz

11th From May 26 to 30	Introduction to Remote Sensing II 11.1 Image Classification 11.2 Change Detection 11.3 Applications in Plant Sciences, Earth Sciences, Land Use and Land Cover and Global Remote Sensing Read: Chapters 3 & 6 of Campbell (2011) Introduction to Remote Sensing.	SNAP Practical II QGIS Practical X Week 11 Quiz Evaluation AAA II No 1
UNIT OF LEARNING III: GIS Analysis in Action: Understanding Our World. Apply GIS tools and techniques to resolve real life situations. Analyze GIS innovations and industry applications.		
12th From June 02 to 06	**Environmental Applications of GIS I: Emergency Management** 12.1 The Fours Stages of Emergency Management 12.2 Geospatial Approaches and Technology in Emergency Management Case Study: (Re)Insurance Industry Read: Chapter 2 of Tomaszewski, B., (2014). Geographic Information Systems (GIS) for Disaster Management.	SNAP Practical III QGIS Practical XI Week 12 Quiz
13th From June 09 to 13	**Environmental Applications of GIS II** Case Study: GIS and Earth Observation for Sustainable Development I – Climate Change	SNAP Practical IV QGIS Practical XII Week 13 Quiz Evaluation AAA II No 2.
14th From June 16 to 21	**Environmental Applications of GIS III** Case Study: GIS in Water Resources Management	SNAP Practical V QGIS Practical XIII Week 14 Quiz
15th From June 23 to 28	**Course Summary & Final project Presentations**	Evaluation Final Project Presentation
16th From June 30 to July 04	**Final Exams**	

VIII. Bibliography

- Bolstad, Paul (2016). GIS Fundamentals: A first text on geographic information systems, 4th edition.
- Campbell (2011) Introduction to Remote Sensing. 5th Edition.

- Capineri, C, Haklay, M, Huang, H, Antoniou, V, Kettunen, J, Ostermann, F and Purves, R (2016). European Handbook of Crowdsourced Geographic Information. London: Ubiquity Press.
- Kraak, MJ & Ormeling, F (2010). Cartography: Visualization of Geospatial Data. Third Edition. Pearson Education Limited.
- Peterson, G (2015). GIS Cartography: A Guide to Effective Map Design. Second Edition.
- Sobel, D & Andrewes, WJH (1998). The Illustrated Longitude: The True Story of the Lone Genius Who Solved the Greatest Scientific Problem of His Time.
- Tomaszewski, B., (2014). Geographic Information Systems (GIS) for Disaster Management

IX. Lecturer

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