湖北工業大學
HUBEI UNIVERSITY OF TECHNOLOGY

Course Title	Geographic Information Systems Applications
Course Code	ENVT 4413
Semester	Winter 2027
Course Length	8 Weeks, 60 Contact Hours
Credits	4
Instructor	TBA
Office	TBA
Email	TBA
Prerequisite(s)	N/A
Antirequisite	ENVT 4411 Geographic Information Systems Applications (4 Weeks)

Course Description:

Everything on the Earth exists in some place and time. Location is an important part of understanding the nature of a phenomenon and its relationships with other aspects of a system. Geographic Information Systems (GIS) are now widely accepted as a technology for examining objects and events in space and time, and spatial analysis is an important skill required in many disciplines and careers.

This course introduces postgraduate students to GIS, providing training in both the use of the software and the analysis of spatial data. The course covers the application of GIS across a number of fields and disciplines. Students are introduced to core concepts in GIS and analytical techniques, including spatial sampling, interaction models, and spatial statistics. Instruction is also provided in the presentation of spatial data and the development of a spatial analytic project from start to finish.

The goal of the course is to develop an understanding of spatial data and spatial analysis, to develop spatial problem-solving abilities, and to acquire knowledge and skills in GIS across a broad set of applications. Lectures cover fundamentals in the spatial representation of real-world objects, map projections, cartography, data development, and spatial analytic techniques. Laboratories follow lecture and discussion to optimise learning.

Course Goals:

Students who successfully complete this course will demonstrate competency in the following general education core goals:

- **Critical Thinking Skills** - Students will engage in analytical thinking, demonstrating the ability to critically evaluate, synthesize, and apply knowledge to complex problems, and construct well-reasoned solutions and arguments.
- **Independent Research and Inquiry** - Students will conduct independent research, utilizing academic resources to explore relevant topics, formulating research questions, analyzing data, and presenting findings in a coherent, scholarly manner.
- **Problem-Solving and Application** - Students will apply theoretical concepts and methodologies learned in the course to real-world problems, demonstrating the ability to develop practical solutions informed by academic inquiry.
- **Global and Cultural Awareness** - Students will gain awareness of the global and cultural contexts relevant to the course, appreciating diverse perspectives and considering the implications of their studies in a broader, international context.

Student Learning Outcomes:

Upon completion of this course, students will be able to:

- Recognise different types of spatial data and identify how geographic information is related through space and time using core GIS concepts such as interactivity and interdependency.
- Operate QGIS software to analyse different types of geospatial data.
- Apply a range of spatial processing techniques, including spatial statistics, to assess both vector and raster datasets.
- Communicate geospatial information using clear and informative mapping approaches that follow fundamental principles of cartography.
- Source spatial data and combine multiple analyses to address geographic research questions.
- Plan, execute, and document an end-to-end spatial analytic project addressing a defined environmental or geographic problem.

Textbooks:

1) Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2021). *Geographic Information Science and Systems* (4th ed.). Wiley.
2) QGIS Project. (2024). *QGIS User Guide: QGIS Documentation*. QGIS Project.
3) Mitchell, A. (2005). *The ESRI Guide to GIS Analysis, Volume 2: Spatial Measurements and Statistics.* ESRI Press.
4) Bivand, R. S., Pebesma, E., & Gómez-Rubio, V. (2013). *Applied Spatial Data Analysis with R (2nd ed.).* Springer.
5) Kraak, M.-J., & Ormeling, F. (2011). *Cartography: Visualization of Geospatial Data (3rd ed.).* Routledge.

Course Requirements:

Practical Skills Evaluation (20%)
A supervised laboratory assessment in which students demonstrate hands-on competence with GIS software operations, spatial data handling, and core analytical techniques under timed conditions.

Practical Exercises (30%)
A sequence of weekly GIS practical exercises applying the techniques introduced in lectures and workshops. Exercises cover data acquisition, vector and raster processing, spatial statistics, and cartographic output, and must be completed in the accompanying computer laboratories.

Spatial Analysis Project Report (35%)
Students develop an end-to-end spatial analytic project addressing a defined geographic or environmental research question. The project should include:

- Problem definition and study-area description
- Spatial data sourcing, preparation, and quality assessment
- Selection and justification of appropriate spatial methods
- Analysis of vector and/or raster datasets using spatial statistics
- Cartographically sound maps and visualisations
- Interpretation, limitations, and recommendations.

The project will be assessed through a written report and a set of project maps.

Workshop Participation and Independent Learning (15%)
Students are expected to complete preparatory podcasts and readings, attend compulsory workshops, contribute to interactive discussions, and complete laboratory work that enables the skills required for the written assessments.

Assessments: Activity	**Percent Contribution**
Practical Skills Evaluation	20%
Practical Exercises	30%
Spatial Analysis Project Report	35%
Workshop Participation and Independent Learning	15%

Grading:

Final grades will be based on the sum of all possible course points as noted above.

Grade	**Percentage of available points**
A	94-100
A-	90-93
B+	87-89
B	84-86
B-	80-83
C+	77-79
C	74-76
C-	70-73
D	64-69
D-	60-63
F	0-59

Course Schedule:
The schedule of activities is subject to change at the reasonable discretion of the instructor. Minor changes will be announced in class, major ones provided in writing.

ENVT 4413 Schedule		
Lecture	Topic	Readings
L1	Introduction to GIS and Spatial Thinking	Longley et al. (2021). *Geographic Information Science and Systems*, Ch. 1-2.
L2	Representing the Real World: Vectors, Rasters, and Data Models	Longley et al. (2021). *Geographic Information Science and Systems*, Ch. 3.
L3	Map Projections, Coordinate Systems, and Spatial Reference	Kraak & Ormeling (2011). *Cartography: Visualization of Geospatial Data*, Ch. 2.
L4	GIS Data Sources, Acquisition, and Data Quality	QGIS Project (2024). *QGIS User Guide: Managing Data Sources*.
L5	Cartographic Principles and Map Design	Kraak & Ormeling (2011). *Cartography: Visualization of Geospatial Data*, Ch. 5-6.
L6	Vector Data Processing and Spatial Operations	Longley et al. (2021). *Geographic Information Science and Systems*, Ch. 9.
L7	Raster Data Analysis and Surface Modelling	Mitchell (2005). *The ESRI Guide to GIS Analysis, Vol. 2*, Ch. 3.
L8	Spatial Sampling and Spatial Sampling Design	Bivand, Pebesma & Gómez-Rubio (2013). *Applied Spatial Data Analysis with R*, Ch. 2.
L9	Interaction Models and Spatial Relationships	Mitchell (2005). *The ESRI Guide to GIS Analysis, Vol. 1*.
L10	Descriptive Spatial Statistics and Point Pattern Analysis	Mitchell (2005). *The ESRI Guide to GIS Analysis, Vol. 2*, Ch. 4-5.
L11	Spatial Autocorrelation and Hot-Spot Analysis	Bivand, Pebesma & Gómez-Rubio (2013). *Applied Spatial Data Analysis with R*, Ch. 7.
L12	Overlay, Suitability, and Multi-Criteria Analysis	Longley et al. (2021). *Geographic Information Science and Systems*, Ch. 15.
L13	Network and Proximity Analysis	Mitchell (2005). *The ESRI Guide to GIS Analysis, Vol. 1*, Ch. 4.
L14	Terrain Analysis and Hydrological Modelling	QGIS Project (2024). *QGIS User Guide: Terrain Analysis Tools*.
L15	GIS in Environmental Science, Planning, and Natural Resource Management	Longley et al. (2021). *Geographic Information Science and Systems*, Ch. 18.
L16	Remote Sensing Imagery and GIS Integration	Longley et al. (2021). *Geographic Information Science and Systems*, Ch. 10.
L17	Uncertainty, Error, and Data Limitation in Spatial Analysis	Longley et al. (2021). *Geographic Information Science and Systems*, Ch. 6.
L18	GIS Project Design and Research Question Formulation	Bivand, Pebesma & Gómez-Rubio (2013). *Applied Spatial Data Analysis with R*, Ch. 1.
L19	Project Workshop: Data Preparation and Analysis	QGIS Project (2024). *QGIS User Guide: Working with Vector and Raster Layers*.
L20	Project Workshop: Mapping, Interpretation, and Reporting	Kraak & Ormeling (2011). *Cartography: Visualization of Geospatial Data*, Ch. 7.
L21	Introduction to Spatial Modelling and GIS Programming Concepts	Bivand, Pebesma & Gómez-Rubio (2013). *Applied Spatial Data Analysis with R*, Ch. 8.

L22	Communicating Spatial Results to Academic and Stakeholder Audiences	Kraak & Ormeling (2011). *Cartography: Visualization of Geospatial Data*, Ch. 8.
L23	Ethics, Privacy, and Responsible Use of Geographic Information	Longley et al. (2021). *Geographic Information Science and Systems*, Ch. 19.
L24	Project Presentations, Peer Review, and Course Synthesis	Course readings and project materials listed in L5, L12, and L20.
L25	Final Examination	Review all materials.

Accommodation Statement:

Academic accommodations may be made for any student who notifies the instructor of the need for an accommodation. It is imperative that you take the initiative to bring such needs to the instructor's attention. Students who may require assistance in emergency evacuations should contact the instructor as to the most appropriate procedures to follow.

Academic Integrity Statement

Each student is expected to maintain the highest standards of honesty and integrity in academic and professional matters. The University reserves the right to take disciplinary action, up to and including dismissal, against any student who is found guilty of academic dishonesty or otherwise fails to meet the standards. Any student judged to have engaged in academic dishonesty in coursework may receive a reduced or failing grade for the work in question and/or for the course.

Academic dishonesty includes, but is not limited to, dishonesty in quizzes, tests, or assignments; claiming credit for work not done or done by others; hindering the academic work of other students; misrepresenting academic or professional qualifications within or without the University; and nondisclosure or misrepresentation in filling out applications or other University records.

Other Items:

Attendance and Expectations

All students are required to attend every class, except in cases of illness, serious family concerns, or other major problems. We expect that students will arrive on time, be prepared to listen and participate as appropriate, and stay for the duration of a meeting rather than drift in or out casually. In short, we anticipate that students will show professors and fellow students maximum consideration by minimizing the disturbances that cause interruptions in the learning process. This means that punctuality is a must, that cellular phones be turned off, and that courtesy is the guiding principle in all exchanges among students and faculty. You will be responsible for the materials and ideas presented in the lecture.

Assignment Due Dates

All written assignments must be turned in at the time specified. Late assignments will not be accepted unless prior information has been obtained from the instructor. If you

believe you have extenuating circumstances, please contact the instructor as soon as possible.

Make-Up Work
The instructor will not provide students with class information or make-up assignments/quizzes/exams missed due to an unexcused absence. Absences will be excused and assignments/quizzes/exams may be made up only with written documentation of an authorized absence. Every effort should be made to avoid scheduling appointments during class. An excused student is responsible for requesting any missed information from the instructor and setting up any necessary appointments outside of class.

Access, Special Needs, and Disabilities
Please notify the instructor at the start of the semester if you have any documented disabilities, a medical issue, or any special circumstances that require attention, and the school will be happy to assist.