UAB
Universitat Autònoma de Barcelona

Modelling and Simulation of Urban Systems

Code: 106954
ECTS Credits: 6

2025/2026

Degree	Type	Year
Management of Smart and Sustainable Cities	OB	4

Contact

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

Having completed a first course in geographic information systems is practically essential, as well as having basic knowledge in the bases for geoinformation.
Many of the bibliography of the subject is in the English language, so the student should be able to at least read in that language.

Objectives and Contextualisation

After a first course in Geographic Information Systems (GIS or SIG), in which solid knowledge based on the conceptual and methodological foundations of the discipline and an important practical skill have been achieved, this course constitutes an applied approach in the context of the management, analysis, representation, etc., of the geographic information from the environment of a GIS applied to the modeling and simulation of urban systems. The course, however, also aims to expand knowledge in its own field, so the objectives are both of a theoretical nature, as corresponds to a second level in which we must consolidate, deepen or expand knowledge, as well as of practical nature, in this case no longer in the form of the small examples of a first course, but as application cases derived from the needs in research, geographic information, interpretation of data and analysis and modeling of urban networks, in some cases, with application to real systems.
The course does not intend to train in a specific software, but to understand the logic of geographic information systems and modeling, the basic operations and the common and more specific applied tools of some software. The student will have to learn the necessary concepts, understand what strategies it is convenient to plan and decide which operations to apply in each case to obtain the desired results.
The very maturity of the use case will allow the students to find what functionalities they need from the software in each situation and choose or adapt to the possibilities that they will find at each moment and place of the future development of their activity.

One of the objectives of the course will also be to know own dynamics and practical cases of modeling of urban systems and networks (such as road networks, public transport networks, urban freight transport distribution or minimum transport routes) and to know cases applied to elements of inventory andcontrol of assets with GIS tools.
Among the objectives set out in the course are:
• Expand knowledge on formats and data sources useful for the realization of geographical studies of all kinds; Attention will be paid to both de facto and de jure standards. The theoretical discourse will be dressed with a series of examples both from the most conceptual point of view (punctual data of irregular geographical

distribution, zonal data, etc., in different formats and origins, with special attention to those provided through Internet) and thematic (demographic data, public transport, inventory of assets, etc). In this context, knowledge about the meaning, interest and use of metadata standards, on spatial data infrastructures and remote sensing will be expanded, briefly introducing some new data exchange and input formats, paying special attention to the advantages and inconveniences that these can generate for end users.
• Identify and use different sources of information data, as well as its operating principles, access policies and standards.
• Reinforce the practice of digitization and topological vector structuring as one of the basic sources of data incorporation into a GIS. This objective will be achieved in many applied cases and will be completed with the reworking of materials in classical operations such as the grouping of polygons by thematic criteria, etc.
• Know some applications and methods of generation of the most common types of digital models and their practical application in dynamics and urban environments.
• Reinforce the knowledge of the GIS analysis tools in the context of the real applications raised in the course, analyzing and presenting some use cases on the modeling of urban and territorial dynamics such as public transport networks, control of assets on public roads, etc.
• Know how to integrate previous knowledge so that the student is able to take geographic information and, autonomously, integrate it into a GIS to analyze it. The compilation of regional information onvarious aspects, human and physical, and its correct structuring and documentation prior to the application of modeling or simulations is a summary objective of the course.
• Learn to present their own works and small projects related to the search of data and result publication, evaluate critically their own work, taking care of the style and presentation formats.

Learning Outcomes

1. CM10 (Competence) Develop projects related to the management, equity and sustainability of cities by applying elements of technological innovation, such as information and communication technologies.
2. KM15 (Knowledge) Identify different primary and secondary sources, models and databases of information generated by urban activity, as well as their operating principles, access policies and standards.
3. SM12 (Skill) Select relevant geographical information and its main forms of expression in the context of urban analysis.

Content

The various aspects to be developed in the course are:
Formats, standards and data sources
Preparation of data for modeling and simulation in urban systems
Digitizing and advanced topological structuring
Generation and use of terrain models and spatial interpolation
Multicriteria models in GIS
The application in practical cases will be developed throughout the course, in an integrated way in the various subjects covered in the course.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Autonomous			
Class practices done independently by the students	25	1	CM10, KM15, SM12, CM10

Class practices done independently by the students	75	3	CM10, KM15, SM12, CM10
Material provided and reading guides	22	0.88	CM10, KM15, SM12, CM10
Problems sessions	10	0.4	CM10, KM15, SM12, CM10
Provided practice development guides	15	0.6	CM10, KM15, SM12, CM10

Methodology
Type: Autonomous
Study of theoretical material
Class practices done independently by the students
Type: Directed
Theoretical classes / Material provided and reading guides
Teacher-guided class practices / Provided practice development guides
Problems sessions
Type: Supervised
Personalized attention to the student (appointments, tutorials)
The contents of the subject will be developed through the following activities:
- Oral presentations and facilitation of materials and reading guides by the teacher.
- Reading of chapters of books or articles (individual activity of students complementary to classroom work).
- Teacher-guided class practices
- Practices and presentations carried out autonomously by the students on proposals from the teacher.
The preferred form of communication with students will be the email and notification channel of the moodle classroom which is the virtual platform used.
Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

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Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Assignments delivered along the course	45%	0	0	CM10, KM15, SM12
course practical exam in computer lab	25%	2	0.08	CM10, KM15, SM12
course theory exam	30%	1	0.04	CM10, KM15, SM12

The evaluation activities are:
1 / Theoretical exams (30% of the grade) taken at mid-course and at the end of the course, and practical exams with a computer (25% of the grade) also taken at mid and end of the course. These exams are in person and may include activities such as those developed in the classroom practices in the theoretical and activities of the style developed in the computer lab in the practical. The dates of these exams are published at the beginning of the course. To be able to attend to the re-evaluation exam it is mandatory to have completed at least one of the partial exams.
2 / Exercises delivered throughout the course (45% of the grade). To be able to attend to re-evaluation exam, it is mandatory to submit at least more than 50% of the evaluable exercises. The evaluable exercises not

delivered will average with the other exercises, with a score of 0. The evaluable exercises not delivered within their period could be delivered later, but it must be considered that they will have a penalty in their qualification and that it must always be before the publication of the qualifications of the exercises delivered into the normal period.
The pass is obtained with a 5. It will be considered "Not Evaluable" the student who has not submitted to any of the two theoretical tests, nor to the re-evaluation test, or that has not submited more than 50% of evaluable exercises. Additionally, in order to be able to be evaluated (and obtain the average of course) it is necessary:
a minimum grade of 3 for the average of the theorical exams
a minimum grade of 3 for the average of the practical exams
a minimum grade of 4 for the average overall corresponding to the 4 exams
There will be a re-evaluation test for those people who have been evaluated continuously, but do not pass the minimum grade of5. In order to attend to the re-evaluation exam it will be necessary to have submited 50% of the individual exercises and to have attended to at least one partial exam. The student can decide to take the re-evaluation exam ony for the parts that they have not passed: only theoretical exam, only practical exam or both; as well as for the part of the courses needed: only the first part of the course, only the second part or all. The grade of the exam re-evaluation exam will substitute the corresponding previous part of the exam (theoretical or/and parctical first and/or second part) for the calculation of the final note, even if the note of the r-evaluation exam is lower than the previous one. The student who attend to the re-evaluation exam can have a final grade higher than 5. The evaluable exercises cannot be submited for re-evaluation.
The copying or plagiarism of material, both in the case of works and in the case of examinations, constitute a crime that will be sanctioned with a zero in the activity. In the case of recidivism, the entire subject will be

suspended. Let's remember that a "copy" is considered a work that reproduces all or most of the work of one or more partners. "Plagiarism" is the fact of presenting all or part of an author's text as its own, without citing the sources, whether in paper or in digital format. See UAB documentation on "plagiarism" at: http://wuster.uab.es/web_argumenta_obert/unit_20/sot_2_01.html.
Honors grade: Granting an honors grade is the decision of the faculty responsible for the course. Honors will be awarded only to students who have shown a high level of excellence in the course, and not by default to those who have obtained the highest mark. UAB regulations state that MHs can only be awarded to students who have obtained a final grade equal to or higher than 9.00. Up to 5% of thetotal number of students enrolled can be awarded with honors grade.
No differentiated treatment is considered for repeat students.

Bibliography

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Chuvieco, E. (2010). "Teledetección Ambiental", Barcelona, Ariel. 592 p. 3ª edició.
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Mitchell, A. (1999) ."The ESRI Guide to GIS Analysis". Volume 1: Geographic Patterns and Relation-ships. Redlands (California, USA): Environmental Systems Research Institute, Inc. 186 p.
Nunes, J. (2012). "Diccionari terminològic de sistemes d'informació geogràfica". Enciclopèdia Catalana i Institut Cartogràfic de Catalunya, Barcelona. 551 p. Consultable a http://www.termcat.cat/ca/Diccionaris_En_Linia/197
Ortúzar, J., Willumsen, L. (1998), "Modelling Transport", 4th Edition. Wiley.
Pons, X., Arcalís A. (2012). "Diccionari terminològic de Teledetecció". Enciclopèdia Catalana i InstitutCartogràfic de Catalunya, Barcelona. 597 p. Consultable a http://www.termcat.cat/ca/Diccionaris_En_Linia/197

Seguí, J.M., Petrus, I.M.. (1991). "Síntesis Geografía de redes y sistemas de transporte". 201 p.

Software

GIS: ArcGIS Pro
Urban modeling: FME

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.