COURSE DESCRIPTION

Computer-aided design for environmental protection

Academic year 2026-2027

1. Programme-related data

1.1. Higher Education Institution	Babeș-Bolyai University of Cluj-Napoca
1.2. Faculty	Environmental Science and Engineering
1.3. Department	Environmental Analysis and Assessment
1.4. Field	Environmental Engineering
1.5. Level of study	Master
1.6. Degree programme / Qualification	Sustainable Development and Environmental Management / Environmental Engineer
1.7. Form of education	Full-time

2. Course-related data

2.1. Course title	Computer-aided design for environmental protection			Course code	NME8022
2.2. Course coordinator	Assistant Prof., PhD Manciula Dorin				
2.3. Seminar coordinator	Assistant Prof., PhD Manciula Dorin				
2.4. Year of study	2	2.5. Semester	II	2.6. Type of assessment	Exam
2.7. Course status	Compulsory			2.8. Course type	Core subject

3. Total estimated time (hours per semester of teaching activities)

3.1. Number of hours per week	5	of which: 3.2. course	2	3.3. seminar/ laboratory/ project	3
3.4. Total of hours in the curriculum	70	of which: 3.5. course	28	3.6. seminar/ laboratory	42
Time allocation for individual study (IS) and self-taught activities (ST)					**hours**
Learning from textbooks, course materials, bibliography, and notes (IS)					40
Additional research in the library, on subject-specific electronic platforms, and on-site					20
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays					40
Tutoring (professional guidance)					2
Examinations					4
Other activities					8
3.7. Total hours of individual study (IS) and self-taught activities (ST)				110	
3.8. Total hours per semester				175	
3.9. Number of credits				7	

4. Prerequisites (where applicable)

4.1. curriculum-related	Applied mathematics in environmental engineering and geometry. Basics of environmental engineering: ecological processes, transport and transfer processes, descriptive geometry and computer assisted graphics.
4.2 skills-related	Basic notions of drawing and engineering, information and documentation, teamwork, use of computer technologies for acquisition and processing of graphic data. Technical: use of computer software.

5. Specific conditions (where applicable)

5.1. course-related	Necessity of digital (video) projector and a computer / laptop, teaching space (20 – 25 seats).
5.2. seminar/laboratory-related	Teaching laboratory / room A.1.6, equipped with computers and specific programs (software).

6.1. Competencies resulting from the completion of the degree programme *(as referred to in the curriculum)*[1]

Professional competencies	
Competency code	**Competency**
PC9	Use technical drawing software: Create technical designs and technical drawings using specialized software.
PC11	Develop sewerage networks: Develop systems and methods of construction and installation of wastewater transportation and treatment equipment, which is used to transport wastewater from residences and facilities through water treatment facilities, or through other sewerage systems, to ensure proper disposal or reuse. Develop such systems with environmental and sustainability concerns in mind.
Transversal competencies	
Competency code	**Competency**
TC2	Work in teams: Work confidently within a group with each doing their part in the service of the whole.
TC3	Dealing with problems: Develop and implement solutions to practical, operational or conceptual problems which arise in the execution of work, in a wide range of contexts.
TC4	Working with numbers and measures: Apply numerical and mathematical content, information, ideas and processes to meet basic demands of learning and work. This includes an understanding of numbers, patterns, shape and space, the mathematical language, symbols and procedures, and ways of thinking used to achieve concrete goals.

6.2. Learning outcomes relevant to the degree programme (as referred to in the curriculum)[2]

Learning outcomes targeted by the subject		
Competency code	**Knowledge and comprehension**	**Specific academic skills**
PC9, TC4	1. The student / graduate describes, identifies, and summarizes fundamental concepts and principles in the technical-engineering field (environmental engineering).	1. The student / graduate applies fundamental methods of simulation, design, and process modelling. The student / graduate discovers, measures, analyses, and evaluates process parameters. The student / graduate designs technological workflows according to specific requirements.
PC11, TC4	2. The student / graduate describes, identifies, and summarizes basic concepts and methods in the field of environmental engineering, including physics, environmental chemistry, and ecological biology, to understand the impact of human activities on the environment.	2. The student / graduate identifies, measures, and evaluates the characteristics of the environment, its hazards and vulnerabilities, and the impact of pollution on ecosystems. The student / graduate uses modern tools and technologies for environmental monitoring. The student/graduate designs strategies for risk reduction and for managing the impact of pollution on the environment. The student / graduate identifies and applies efficient techniques for waste treatment and recovery in a sustainable manner, in accordance with the principles of the circular economy.

[1] The professional and/or transversal skills targeted by the subject for which the course description is prepared will be copied from the curriculum of the degree programme. For each competency, the complete entry, including the competency code, will be copied with the exact wording that appears in the curriculum, without any changes. If no competency is copied from either of the two categories, the row corresponding to that category is deleted from the table.

[2] The learning outcomes relevant for the degree programme and targeted by the subject for which the course description is prepared will be listed. The entries, copied without any changes from the Curriculum by subject type (Core Subject/Specialisation Subject/Complementary Subject), are listed under the corresponding competency.

7. Subject-specific learning outcomes (referred to by each subject coordinator across the range of competencies and learning outcomes at the level of the degree programme)

Knowledge and comprehension
1. The student is familiar with the basic techniques used in computer-aided graphics, including the use of 2D and 3D drawing and modelling software.
2. The student understands the fundamental principles of visual design (drawing formats or file formats for different working environments, etc.).
3. The student is familiar with the principles of visual design, virtual modelling, and the software used in technical graphics.
4. The student can select and apply the appropriate graphic tools according to the project requirements.
5. The student understands the fundamental principles of CAD and the software used in environmental protection studies, including modelling, simulation, and presentation of results and calculations. They are familiar with environmental impact assessment methods, relevant regulations and sustainability concepts, and can integrate ecological solutions into design projects. The student is also able to analyze and interpret data from CAD simulations and models.
Specific academic skills
1. The student can use theoretical and practical knowledge in computer-aided graphics to create high-quality graphic design projects.
2. The student demonstrates proficiency in technical execution, creative thinking, and problem-solving within graphic design.
3. The student strengthens practical skills in creating and editing images, visual elements, drawings, sketches, and scale models, and can apply advanced techniques of retouching, compositing, and manipulation.
4. The student can independently manage and complete graphic design assignments and projects from concept to final product, as well as develop original concepts.
5. The student can apply innovative solutions to technical and creative problems, collaborate effectively within interdisciplinary teams, manage time and resources efficiently to meet deadlines, organize their work, and assume responsibility for the quality and originality of the output produced.
6. Students can work effectively in teams, exchange ideas, develop their own project versions, and present them in a professional manner.

8. Contents

8.1. Course	**Teaching and learning methods**	**Remarks[3]**
C1. Introduction to computer graphics. Backgrounds, opportunity and motivation of ecological and engineering design. History of technical graphic design.	Interactive exposure, explanation, conversation, didactical demonstration.	Attending the course is optional
C2. Elements of descriptive geometry. Notations and symbols. Projection systems and reference systems. Modelling theory. Conceptual models. Graphic examples.	Interactive exposure, explanation, conversation, didactical demonstration.	Attending the course is optional
C3. Geometric modelling. Conventions and notations. Graphic examples.	Interactive exposure, explanation, conversation, didactical demonstration.	Attending the course is optional
C4. Curves. Hermite curves. Bezier curves. B-spline curves. Graphic examples.	Interactive exposure, explanation, conversation, didactical demonstration.	Attending the course is optional
C5. Surfaces. Explicit, implicit and parametric equations of surfaces. Points on the surface. Embedded curves. Graphic examples.	Interactive exposure, explanation, conversation, didactical demonstration.	Attending the course is optional
C6. Raster scan graphics. Drawing algorithms. Graphic examples.	Interactive exposure, explanation, conversation, didactical demonstration.	Attending the course is optional

[3] For example, organisational aspects, recommendations for students, specific aspects relating to the course/seminar, such as inviting experts in the field, etc.

C7. Clipping. 2D clipping. 3D clipping. Graphic examples.	Interactive exposure, explanation, conversation, didactical demonstration.	Attending the course is optional
C8. Visible lines and visible surfaces. Algorithms. Graphic examples.	Interactive exposure, explanation, conversation, didactical demonstration.	Attending the course is optional
C9. Rendering. Illumination models. Transparency. Shadows. Textures. Ray tracing. Radiosity. Color. Graphic examples.	Interactive exposure, explanation, conversation, didactical demonstration.	Attending the course is optional
C10. The bicubic Hermite surface. Bezier surfaces. B-spline surfaces. Graphic examples.	Interactive exposure, explanation, conversation, didactical demonstration.	Attending the course is optional
C11. Solids. Parametric solids. Tricubic solid. Curves and surfaces embedded in a solid. Controlled deformation solids. Graphic examples.	Interactive exposure, explanation, conversation, didactical demonstration.	Attending the course is optional
C12. Complex model construction. Topology of models. Boolean and boundary models. Graphic examples.	Interactive exposure, explanation, conversation, didactical demonstration.	Attending the course is optional
C13. Relational geometric synthesis. Relational model structure. Relational entities. Applications. Graphic examples.	Interactive exposure, explanation, conversation, didactical demonstration.	Attending the course is optional
C14. Graphic design software. 2D design. 3D design. Examples.	Interactive exposure, explanation, conversation, didactical demonstration.	Attending the course is optional

Bibliography

- Moncea J. - Geometrie descriptivă și desen tehnic, Vol. I, Editura Didactică și Pedagogică, București, 1982;
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- Mortenson M. E. - Geometric modeling, Wiley Computer Publishing, 1996;
- Bilalis N. - Computer aided design - CAD, Technical University of Crete, 2000;
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- Hervay P., Horváth R., Kátai L., Madarász I. - CAD Book. Course bulletin, Budapest University of Technology and Economics Faculty of Mechanical Engineering, 2012;
- Mustun A. - An introduction to computer aided design (CAD), RibbonSoft, GmbH, 2016;
- Pell M. – Envisioning holograms. Design breakthrough experienceses for Mixed Reality, Apress, 2017;
- Dejian L., Dede C., Huang R., Richards J. – Virtual, augumented and mixed realities in education, Springer, 2017;
- De Paolis L. T., Bourdot P., Mongelli A. – Augumented reality, virtual reality and computer graphics, 4th International conference, AVR 2017 Ugento, Italy, June 12-15, 2017 – Proceedings, Part II, Springer, 2017;
- Arnaldi B., Guitton P., Moreau G. – Virtual reality and augumented reality. Myths and realities, John Wiley & Sons Inc., Hoboken, New Jersey, 2018;
- Mueller P. J., Massaron L. - Artificial inteligence for dummies, Wiley & Sons Inc., Hoboken, New Jersey, 2018.

8.2. Seminar/ laboratory	**Teaching and learning methods**	**Remarks**
S1/L1.General presentation of computer graphic programs - CAD software and tools. Ecological and engineering design concept.	Lab assignment, explanation, conversation.	Individual work
S2/L2.2D and 3D software presentation. General data presentation for individual project. Ecological and technical data and processes analysis.	Lab assignment, explanation, conversation.	Individual work
S3/L3.Introduction to CAD 2D software. Description and use of 2D software. Drawing elements, tools and procedures.	Lab assignment, explanation, conversation.	Individual work with software

S4/L4. Making sketches and profiles with dedicated graphics software (2D CAD) - Part 1.	Lab assignment, explanation, conversation.	Individual work with software
S5/L5. Making sketches, maps and profiles with dedicated graphics software (2D CAD) - Part 2	Lab assignment, explanation, conversation.	Individual work with software
S6/L6. Making sketches, models and profiles with dedicated graphics software (2D CAD) - Part 3	Lab assignment, explanation, conversation.	Individual work with software
S7/L7. Introduction to 3D software. Description and use of 3D software. Drawing elements, tools and procedures.	Lab assignment, explanation, conversation.	Individual work with software
S8/L8. Making sketches and profiles with dedicated graphics software (3D CAD) - Part 1.	Lab assignment, explanation, conversation.	Individual work with simulation software
S9/L9. Making sketches and profiles with dedicated graphics software (3D CAD) - Part 2.	Lab assignment, explanation, conversation.	Individual work with software
S10/L10. Making sketches and profiles with dedicated graphics software (3D CAD) - Part 3.	Lab assignment, explanation, conversation.	Individual work with software
S11/L11. Generating virtual environments with dedicated graphics software (3D) - Part 1.	Lab assignment, explanation, conversation.	Individual work with software
S12/L12. Generating and modeling virtual environments with dedicated graphics software (3D) - Part 2.	Lab assignment, explanation, conversation.	Individual work with software
S13/L13. Generating virtual environments and projects with dedicated graphics software (3D) - Part 3.	Lab assignment, explanation, conversation.	Individual work with software
S14/L14. Presentation of individual tasks.	Conversation	Lab Exam

Bibliography

- Moncea J. – Geometrie descriptivă şi desen tehnic, Vol. I, Editura Didactică şi Pedagogică, Bucureşti, 1982;
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- Tal D. – Rendering in SketchUp. From modeling to presentation for architecture, landscape architecture and interior design, John Wiley & Sons Inc., Hoboken, New Jersey, 2013;
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- Twinmotion documentation (2023) https://www.twinmotion.com/en-US/docs
- EON-XR Platform resources (2023) https://eonreality.com/platform/resources

9. Evaluation

Type of activity	9.1 Evaluation criteria[4]	9.2 Evaluation methods[5]	9.3 Percentage in the final grade
9.4. Course	Level of understanding of concepts.	Written examination / Project presentation (Oral)	50 %
	Theoretical knowledge acquired.		
	Capacity for analysis and interpretation.		
9.5. Seminar/ laboratory	Application of knowledge in practical contexts.	Seminar, practical work / laboratory activity	20 %
	Quality of the assigned tasks (portfolio).	Seminar assignments / practical work tasks	30 %
9.6 Minimum standard for passing			

- Achieving a minimum grade of 5 in each major assessment component (exam/project presentation/ colloquium);
- Meeting the minimum requirements for participation in teaching activities;
- Demonstrating an acceptable level of knowledge and understanding of the subject area, the ability to present this knowledge coherently, and the capacity to apply it in solving various graphical problems;
- A minimum attendance of 80 % in seminar and laboratory activities;
- Successful completion of the course is conditional upon obtaining a final grade of at least 5.

10. SDG labels (Sustainable Development Goals)[6]

	General label for Sustainable Development

Date of entry:
17. 04. 2026

Signature of course coordinator

Signature of seminar coordinator

Date of approval in the department:

Signature of the head of department

[4] The evaluation criteria must directly reflect the learning outcomes targeted at the level of the degree programme respectively at the level of the subject. More specifically, the learning outcomes set out in the expected learning outcomes are assessed.

[5] Both final evaluation methods and ongoing evaluation strategies should be established.

[6] Select a single label which, according to the *Implementation of SDG labels in the academic process*, best matches the subject. If the subject addresses sustainable development in a generic manner (i.e. by presenting/introducing the general framework of sustainable development, etc.), then the Sustainable Development generic label may be applied. If none of the labels describe the subject, select the last option: *"No label applies."*