6. Ecological and energy designs for products

GENERAL INFORMATION ABOUT THE COURSE		
Course coordinator	Ante Čikić, PhD, professor	
Course name	**Ecological and energy designs for products**	
Study program	**Mechanical Engineering**	
Course status	Compulsory	
Year	2	
Semester	3	
Number of credits and teaching methods	ECTS student load coefficient	5
	Number of hours (lectures + seminars + exercises)	30 + 15 + 0

1. DESCRIPTION OF THE COURSE

1.1. Course objectives

Students will present, convey and strengthen the interactive relationship for design, energy and ecology relating to development, durability, economics and sustainability of products. Methods and elements of designing and using products will be elaborated, including the specifics of energy and ecological burdens from products and production, as well as impacts on economic parameters from the wide social community.

1.2. Course enrolment prerequisites *(if applicable)*

No prerequisites

1.3. Expected course learning outcomes

1. Estimating the importance and overall scope of designing products and technical systems on the environment and society.
2. Establish the connection between ecological and energy criteria, laws and standards with product design.
3. Devise ways of raising awareness and advancing the importance of producing sustainable products.
4. Valorise the intensity of the relationship between economic development and sustainable production.
5. Applying appropriate tools to calculate emissions of harmful substances and energy efficiency for certain products and technical systems.
6. Propose ways of reducing emissions of harmful substances and increasing energy efficiency by applying optimal engineering procedures and economic parameters.
7. Select optimal solutions based on ecological, energy and economic parameters.

1.4. Course content

1. Historical development and importance of designing products. Fundamental concepts of design. Principles and factors in sizing products. General and sustainable product design.
2. Impacting factors on product design. Expressive product design: type, quality and colour of materials, creation and machining processes. Aesthetical components and multi-dimensionality of products.
3. Functionality, ergonomics, technologicality of industrial products.
4. Requirements, similarities and differences in developing production and products in relation to economic and technical development, the environment, ecological requirements as well as sources and forms of applicable energies.
5. Principles of local and global strategies in sustainable production, ecological approach to production. Available energy sources and selecting them.
6. Principles and procedures of socially responsible behaviour in using operative tools for local and global estimates of emissions of harmful substances and estimates of energy efficiency for products and/or production.
7. Requirements for eco-friendly products relating to emissions. Designating products. Designation and EU Declaration of Conformity. Presumptions and assessments, conformity management system. Requirements for integral parts and assemblies. Methods for determining general requirements for eco-design. Methods for determining special requirements of eco-design. The CE designation. Internal design control. Self-regulation.
8. Ecological and energy approach to designing suitable products – selecting production: evaluating the environmental burden, environmental fees, environmental permits, applicable technologies for environmental protection.
9. Ecological and energy approach to designing suitable products – production: technologicality, protection, type and consumption of energy, emissions of harmful substances in the environment (directly and indirectly), unit of energy and ecological burden, estimating the lifecycle and conditions of use. Product sensitivity to type improvement and innovation.
10. EU and Croatian legislation for environmental protection (IPPC Directive), legal framework in Croatia (laws, ordinances, recommendations), activities by government bodies, companies, associations.
11. Emission of harmful greenhouse gases in the atmosphere in production processes and energy systems. Threshold conditions and standards. Methods of calculating and assessing process validity.
12. Waste treatment technologies (solid waste, wastewater, hazardous waste, electronic waste, gases). Noise and endangering the environment, protective measures and technical solutions.
13. Proportion of energy in products and manufacturing. Various parameters: food, processing industries, advanced agricultural-technological and pharmaceutical industries. Impacting parameters and possibility of minimising proportion of energy in manufacturing and products.
14. Interdisciplinary features of design: quality, marketing, ergonomics, useful value, value analysis, lifecycle, style and graphics, acceptability.

15. Energy efficiency and ecological scope in designing products and manufacturing sustainability. Example		
1.5. Types of teaching	☒ Lectures ☒ Seminars and workshops ☐ Exercises ☐ Distance learning ☐ Field work	☒ Autonomous exercises ☐ Multimedia and network ☐ Laboratory ☐ Mentor assistance ☒ Other types
1.6. Comments		

1.7. Student obligations *(attendance at classes, lectures, tutorials, seminars)*

- Active participation in classes and online activities.
- Investigating scientific and professional literature (books, articles, projects, analyses…).
- Analytical evaluation of professional texts and synthesising discovering with the aim of deepening knowledge, preparing the seminar paper and presenting it.
- Solving online given tasks.
- Autonomously registering a possible seminar paper topic.
- Filling out periodically online forms for reports on fulfilled tasks and obligations.
- Participating in evaluating seminar papers in accordance with instructions on the course online website.
- Editing and supplementing the seminar paper in accordance with reviews.
- Filling out the online form for final self-assessment.

1.8. Tracking student work (proportion of individual activities in terms of ECTS credits based on the total number of ECTS credits)

Class attendance	1.5	Class participation	0.5	Seminar paper	1.5	Experimental work	
Written exam		Oral exam	1	Essay		Research	0.5
Project		Continual assessment of knowledge		Written seminar paper		Practical work	
Online activity							

1.9. Grading and assessment of student work during the semester and for the final exam *(interim exam, written exam, oral exam)*

Interim exams, written and oral exam.

1.10. **Mandatory literature** (relevant at the time of submitting the proposed study program)

- Ashford, N. A., and Hall R.P. “Technology, globalization, a sustainable development: transformin the industrial state“, Yale University Press, 2011
- Kljajin M., Opalić M., Pintarić A.: „recikliranje električnih i elektroničkih proizvoda“ Milan Opalić (ur.), Strojarski fakultet, Slavonski Brod, 2007.
- Quarante D., Osnove industrijskog dizajna, Sveučilišna naklada Zagreb, 1991.

1.11. Supplementary literature (relevant at the time of submitting the proposed study program)

- Hinrichs, R.A.; Kleinbach, M.: Energy - Its Use and the Environment, Harcourt College Publishers, 2002.
- Heinsohn, R.J.: Sources and Control of Air Pollution, Prentice Hall, 1999.
- Ralph Horne: Life Cycle Assessment: Principles, Practice and Prospects (Paperback) CSIRO PUBLISHING
- Lebel, L., Lorek, S. and Rajesh Daniel: Sustainable Production Consumption Systems: Knowledge, Engagement and Practice, Springer, 2006.
- Life Cycle Assessment, An operational Guide to the ISO standards.

1.12. Manner of tracking quality to ensure the acquisition of exit knowledge, skills and competences

Through the quality assurance system at the University. Student survey.

2. COMBINING THE LEARNING OUTCOMES, TEACHING METHODS AND ASSESSMENT OF THE LEARNING OUTCOMES

2.1. Class participation	*2.2. Student participation*	*2.3. Learning outcome*	*2.4. Assessment method*
Class attendance	Synthesising knowledge and presenting it through participation and presenting what has been learnt	1-4	Partial assessment of knowledge Interim exam (50% of points) Active participation by students in classes (5% of points)
Seminar paper	Drafting and writing up the project task in line with work instructions by applying principles which are presented and commented on at lectures and at the seminar	4-7	Drafting a written report 25% of points)
Seminar paper	Presenting the project task and acquired competences relating to course before students and the teacher	4-7	Presenting the project task (10% of points)
Online activities	Completion of homework based on competences acquired by synthesising knowledge obtained at lectures	1-7	Completion of homework (10% of points)