Wrocław University of Science and Technology
Doctoral School

COURSE CARD

1. Basic information

Course name in English:	Inventive Engineering	
Course name in Polish:	Inżynieria wynalazczości	
Number of hours:	30	
Type of course:	Elective course	
Form of course:	mixed forms (combination of lecture, seminar and laboratory)	
Code of course:	W10IME-SD0035W / MEQ100350W	
Course leader:	dr hab. inż. Sebastian Koziołek, prof. PWr	
Faculty of the course leader:	W10 Faculty of Mechanical Engineering	
Email address of the course leader:	Sebastian.koziolek@pwr.edu.pl	
Scientific discipline(s) assigned to the course (doctoral students representing the marked disciplines can participate in the course):	Architecture and urban planning	☐
	Automation, electronic, and electrical engineering	☐
	Information and communication technology	☐
	Biomedical engineering	☐
	Chemical engineering	☐
	Civil engineering and transport	☐
	Mechanical engineering	☒
	Environmental engineering, mining, and energy	☐
	Mathematics	☐
	Chemical sciences	☐
	Physical sciences	☐
	Management and quality studies	☒

2. Objectives

C1. Acquiring knowledge about the methods of designing inventions with high innovative potential using systematic and heuristic methods.

C2. Acquisition of knowledge in the field of innovation assessment using objective methods.

C3. Acquisition of knowledge in the area of building inventive teams and acquiring knowledge

C4. Acquiring the skills of conceptual design with the use of prototyping

C5. Acquiring the ability to plan and conduct inventive workshops using heuristic and systematic methods such as TRIZ, Synectics, Design Thinking

C6. Acquiring skills in the field of commercialization of inventions and financing engineering

3. Content

Detailed information about the course content, including topics and form of classes.

No.	Topic	Number of hours	Form of classes
1	Methods and tools of inventive design. Lecture and Group Discussion	2	lecture
2	Overview of the methodology of Inventive Engineering. Lecture and Group Discussion	2	lecture
3	Product and service innovation assessment. Case study	2	seminar
4	Forecasting the development of products and services - phase "For", phase "Model". Lecture and Case Study	2	seminar
5	Forecasting the development of products and services - phase "Analyzes", phase "Transfer". Lecture and Case Study	2	seminar
6	Building inventive teams. Lecture and Group Discussion with Interview	2	lecture
7	Heuristic and systematic knowledge acquisition Lecture	2	lecture
8	Conceptual design using heuristic methods part ½ Lecture	2	lecture
9	Conceptual design using heuristic methods part 2/2 Case study	2	seminar
10	Conceptual design using systematic methods part ½ Lecture	2	seminar
11	Conceptual design using systematic methods part 2/2 Case study	2	seminar
12	Development of the design concept in terms of TEES changes: technical and technological, economic, environmental and social. Seminar	2	seminar
13	Financing engineering - preparing a budget for the development and commercialization of inventions Lecture and Group Discussion	2	lecture
14	Financing engineering - raising funds for the development of inventions and their commercialization Lecture and Group Discussion	2	lecture
15	Evaluation classes		Select form

4. Prerequisites

List of prerequisites relating to knowledge, skills and other competences for course participants.

1. The ability to design technical objects.

2. Ability to model CAD geometric parts and assemblies.

3. Ability to work in a team.

5. Learning outcomes

List of learning outcomes at level 8 of the Polish Qualifications Framework assigned to the course (mark the learning outcomes in the last column).

Symbol	Learning outcome	
	KNOWLEDGE. Doctoral student knows and understands:	
SzD_W3	the main trends in the development of the scientific or artistic disciplines covered in the curricula;	☒
SzD_W4	research methodology;	☒
SzD_W5	the rules for the dissemination of scientific results, including in open access mode;	☒
SzD_W6	the fundamental dilemmas of modern civilization;	☒
SzD_W7	the legal and ethical conditions of scientific activity;	☒
SzD_W8	the economic and other relevant conditions of scientific activity;	☒
SzD_W9	basic principles of knowledge transfer to the economic and social spheres and commercialisation of results of scientific activity and know-how related to these results.	☒
	SKILLS. Doctoral student is able to:	
SzD_U2	use knowledge from different fields of science or art to creatively identify, formulate and innovatively solve complex problems or perform research tasks, in particular: - define the purpose and subject of scientific research, formulate a research hypothesis, - develop research methods, techniques and tools, and use them creatively, - draw conclusions on the basis of scientific research; critically analyse and evaluate the results of scientific research, expertise and other creative work and their contribution to knowledge development; transfer the results of scientific activities to the economic and social spheres;	☒
SzD_U3	communicate on specialised topics to the extent that they enable an active participation in the international scientific community;	☒
SzD_U4	disseminate research results, including in popular forms;	☒
SzD_U5	initiate debates and participate in a scientific discourse;	☒
SzD_U6	be able to speak a foreign language at B2 level of the Common European Framework of Reference for Languages to a level that enables them to participate in the international scientific and professional environment;	☒
SzD_U7	plan and implement an individual or collective research or creative activity, including in an international environment;	☒
SzD_U8	independently plan and act for one's own development and inspire and organize the development of others;	☒
SzD_U9	plan classes or groups of classes and implement them using modern methods and tools.	☒
	SOCIAL COMPETENCES. Doctoral student is ready to:	
SzD_K3	fulfilling the social obligations of researchers and creators, initiate public interest activities, thinking and acting in an entrepreneurial way;	☒

SzD_K4	maintaining and developing the ethos of research and creative environments, including: - carrying out scientific activities in an independent manner, - respecting the principle of public ownership of research results, taking into account the principles of intellectual property protection.	☒

6. Evaluation

Short description of the method(s) used to evaluate the learning outcomes assigned to the course, e.g., exam, test, report, presentation, etc.

test

7. Teaching methods

Short description of the teaching methods used during the course, e.g., multimedia presentation, discussion, literature studies, developing written documents, own work, etc.

N1. traditional lecture with the use of transparencies and slides

N2. problem discussion

N3. case study

N4. Team work of students under the supervision of the teacher

N5. self study - preparation for project class

8. Literature

List of primary and secondary literature used to prepare the course and including additional knowledge for participants, e.g., books, textbooks, research papers, standards, web pages, etc.

[1] S. Koziołek. Inventiveness engineering. Methodology of designing innovative technical systems. Publishing House of Wrocław University of Science and Technology, first edition. Wrocław 2019.
[2] T. Arciszewski, Inventive engineering: knowledge and skills for creative engineers. Taylor&Francis, 2016.
[3] W. J. J. Gordon, Synectics. The development of creative capacity. New York: MacMillan publishing co., Inc., 1961.

9. Other remarks

Additional remarks, comments, (e.g., language of the course)

[1] S. Koziołek i T. Arciszewski, „Syntectical building of representation space: a key to computing education”, w Computing in Civil Engineering, 2011, ss. 1–15.
[2] K. Haines-Gadd, Triz for Dummies. Wiley, 2016.