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Engineering Educators Pedagogical Training (ENTER)

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Syllabuses of iPET-3 courses

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ABSTRACT

This deliverable is dedicated to the iPET program for engineering educators' pedagogical training, and focuses on courses for iPET-3 module of the program. The paper provides a brief explanation of iPET program structure, as well as the background for the choice of courses and competences to be formed within such program. The deliverable discloses draft versions of syllabuses for iPET-3 courses: 3.1. Digital education, 3.2. Problem-based, project-based and practice-oriented learning, 3.3. Learning outcomes' assessment, 3.4. Course design, 3.5. Engineering innovation process, 3.6. Final project. Each syllabus provides general information on the course (aim, objectives, content, teaching materials, etc.), structure of the course content and assessment procedures.

INTRODUCTION

This deliverable has been developed within the ENTER project, work package 2 (WP2) – "Development".

The initial task within WP2 was to develop a structure of the iPET program for pedagogical training of engineering educators. This task has been completed by the consortium partners by project meeting in Almaty in October, 2019.

It has been proposed to create 3 iPET modules within the program: iPET-1, iPET-2 and iPET-3. Each of the modules includes a certain set of courses aimed at fostering various competences of engineering educators.

In order to determine the set of courses and competences that should be fostered within the iPET program, the consortium has conducted a massive survey of stakeholders' opinions on this matter. The survey included 5 groups of stakeholders: engineering educators, HEI administration, HEI engineering students, potential employers of HEI engineering graduates and representatives of governmental bodies, involved in education. The number of respondents exceeded 800, representing over 25 regions of Russian Federation and Republic of Kazakhstan. Based on the results of the survey the following structure of iPET modules has been proposed and approved by the consortium:

iPET program	Module		Course	ECTU
iPET-1 (2 ECTU)	**A**	1.1	Innovations in engineering pedagogy	1
		1.2	Time management	0,5
		1.3	Effective interaction	0,5
iPET-2 (8 ECTU)	**A**		1.1, 1.2, 1,3	2
	B	2.1	Enhancement of learning interactivity	2
		2.2	Systems analysis in education	1
		2.3	Pedagogical psychology and communication	1
		2.4	Interaction with stakeholders	1
		2.5	Sustainable development	1
iPET-3	**A**		1.1, 1.2,1,3	2

(20 ECTU)	**B**		2.1, 2.2, 2.3, 2.4, 2.5	6
	C	3.1	Digital education	2
		3.2	Problem-based, Project-based and practice-oriented learning	2
		3.3	Learning outcomes' assessment	2
		3.4	Course design	1
		3.5	Engineering innovation process	2
		3.6	Final project	3

The second task of the WP2 was to develop syllabuses for each of the iPET courses. Each syllabus has been developed by a team of 3 consortium partners, with one leading partner and 2 co-authoring partners. Then, all syllabuses have been reviewed by each partner university of the ENTER project consortium. During an online meeting of ENTER project members in Bratislava, Slovakia, on April 21-23, 2020, all syllabuses and review notes have been presented, discussed and adjusted accordingly, leading to the creation of three deliverables presenting syllabuses (draft v.1) for iPET-1, iPET-2 and iPET-3.

The syllabuses for iPET-3 courses are presented in the following document.

SYLLABUS FOR COURSE 3.1. DIGITAL EDUCATION

INSTITUTION:	**TO BE FILLED LATER**
PROGRAM:	**IPET 3**
COURSE:	**3.1 DIGITAL EDUCATION**

I – IDENTIFICATION						
COMPULSORY COURSE	**CONTACT TIME - HOURS**				**SELF-STUDY HOURS**	**CREDITS ECTS**
	LECTURES	**TUTORIALS**	**PRACTICAL /PROJECT**	**TOTAL**		
DIGITAL EDUCATION	**6**	**6.5**	**18**	**30.5**	**19.5**	**2**

FORMAL PREREQUISITES (IF ANY): 2.1 - ENHANCEMENT OF LEARNING INTERACTIVITY
COURSE WEBSITE URL: TO BE FILLED LATER

II – AIMS, SYNOPSIS, CHARACTERIZATION

Background (max. 600 characters)

As educators face rapidly changing demands, they require an increasingly broader and more sophisticated set of competences than before. In particular, the ubiquity of digital devices and the duty to help students become digitally competent requires educators to develop their own digital competence. On an international and national level, a number of frameworks, self-assessment tools and training programmes have been developed. This course is dedicated to describe the facets of digital competence for educators and to help them assess their competence, identify their training needs and offer targeted training.

Aims– overview (max. 750 characters)

The main aim of the program is updating and improving the professional competence of teachers in the conditions of digitalization of education and develop competencies to design, organize and accompany educational process in X-learning environment. The targeting educator's digital competencies area: professional engagement (collaboration and professional development), digital resources (sourcing, creating and sharing), teaching and learning (managing and orchestrating the use of digital technologies), assessment (using digital technologies and strategies to enhance assessment), empowering learners (enhance inclusion, personalisation and learners' active engagement), facilitating learners' digital competence (creatively and responsibly use digital technologies for information, communication, content creation, wellbeing and problem-solving).

Specific Aims (max. 1000 characters)

Provide description of specific pedagogic objectives

An engineering educator have to use different information flows and up-dated information in his pedagogical practice. Also he should be able to use ICT for students' study support

The specific aims of the course are:

- to introduce educators to digitalization of education as a tool for the formation of professional and supra-professional competences, educators' digital competence (O1);
- to introduce educators to different types of digital resources and technologies in learning and education, methodology of their development(O2);
- to develop an educator's ability to assess the quality of digital educational resources on the basis of a system-activity approach (O3);
- to develop educator's ability to use computer simulation in engineering (O4);
- to form educator's readiness to comply the rules of cyber security in digital education and develop own digital culture (O5);

Contents (max. 1000 characters)

Within the course the next topics will be offered:

- Introduction to the history of the development of information technology. Digital technology nowadays – living with digital technologies.
- Digital technologies using for communication and data storage, cyber security.
- Digital technologies in education: digital educational resources (presentation, interactive posters, electronic textbooks, electronic education materials, distance education, Massive Open Online Courses (MOOCs); electronic journal /diary).
- Using of digital technology in engineering. Computer simulation in engineering, software for solving engineering problems.
- The future of digital technologies. Digital tools for assessing engineering knowledge and skills. Digital technology culture (media literacy, plagiarism, electronic legal reference systems)

Main Teaching Material

1. Brecko B.,Ferrari A. The Digital Competence Framework for Consumers - Publications Office of the European Union – 2016 , **ISBN:** 978-92-79-66965-1 (print),978-92-79-65757-3 (PDF), **ISSN:** 1018-5593 (print),1831-9424 (online) **DOI:** 10.2791/278444 (print), 10.2791/838886 (online)
2. Fielder A., Vuorikari R., Rodriguez P., Nuria P. Y. Background Review for Developing the Digital Competence Framework for Consumers: A snapshot of hot-button issues and recent literature - Publications Office of the European Union – 2016 , ISBN: 978-92-79-63486-4, ISSN: 1831-9424, DOI: 10.2791/780656
3. Vuorikari R., Punie Y.,Carretero G.S., Van Den Brande G. DigComp 2.0: The Digital Competence Framework for Citizens. Update Phase 1: the Conceptual Reference Model. - Publications Office of the European Union – 2016 , ISBN: 978-92-79-66966-8 (print),978-92-79-58876-1 (PDF),978-92-79-63958-6 (ePub), ISSN: 1018-5593 (print),1831-9424 (online), DOI: 10.2791/607218 (print)10.2791/11517 (online)10.2791/520113 (ePub)
4. Redecker C.,Punie Y., European Framework for the Digital Competence of Educators: DigCompEdu - Publications Office of the European Union – 2016 , ISBN: 978-92-79-73718-3 (print),978-92-79-73494-6 (pdf), ISSN: 1018-5593 (print),1831-9424 (online), DOI: 10.2760/178382 (print), 10.2760/159770 (online)
5. Ferguson R., Brasher A., Clow D., Cooper A. Hillaire G., Mittelmeier J., Rienties B., Ullmann Th., Vuorikari R., Vuorikari R, Castaño Muñoz J., Research Evidence on the Use of Learning Analytics: Implications for Education Policy - DigCompEdu - Publications Office of the European Union – 2016 , ISBN: 978-92-79-64441-2 (online),978-92-79-74184-5 (ePub), ISSN: 1831-9424 (online), DOI: 10.2791/955210 (online), 10.2791/326911 (ePub)

6. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2018:22:FIN
7. https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en?2nd-language=de

Complementary Teaching Material

1. Суворова Т.Н. Проектирование и экспертиза электронных образовательных ресурсов в контексте системно-деятельностного полхода в обучении : учеб.-метод. пособие для направления подготовки бакалавров Пед. образование : профили: "Информатика", "Англ. яз." по учеб. дисциплине "Информ. и коммуникацион. технологии в образовании", учителей и слушателей системы повышения квалификации работников образования / Т. Н. Суворова ; ВятГГУ. - Киров : Радуга-ПРЕСС, 2015. - 102 с.. - Библиогр.: с. 100-102. - 500 экз.
2. Зенкина С. В. Электронные образовательные ресурсы в составе информационно-образовательной среды : учеб.-метод. пособие для студентов пед. вузов и слушателей системы повышения квалификации работников образования / С. В. Зенкина, Т. Н. Суворова, М. В. Николаев ; Акад. соц. управления Моск. обл., ВятГГУ. - Киров : Радуга-ПРЕСС, 2015. - 99 с.. - Библиогр.: с. 96-99. - 500 экз.
3. Киселев Г. М. Информационные технологии в педагогическом образовании [Электронный ресурс] : учебник / Г.М. Киселев. – 2-е изд., перераб. и доп.. – Москва : Издательско-торговая корпорация «Дашков и К°», 2016. – 304 с.
4. Майстренко А. В. Информационные технологии в науке, образовании и инженерной практике [Электронный ресурс] : учебное пособие / А. В. Майстренко. – Тамбов : Издательство ФГБОУ ВПО «ТГТУ», 2014. - 97 с.
5. "Интеллектуальное обеспечение перехода Казахстана к цифровой экономике: изменение парадигмы образования и трудовых отношений", междунар. круглый стол (2017 ; Алматы). Материалы Международного круглого стола на интерактивной площадке "G-GLOBAL" "Интеллектуальное обеспечение...", 27 сент. 2017 г.: сборник / М-во образования и науки РК, КазНУ им. аль-Фараби; [под общ. ред. М. С. Тулегеновой]. - Алматы : Қазақ ун-ті, 2017. - 69 с. : ил. - Библиогр. в конце ст. - 25 (тираж) экз. - **ISBN**978-601-04-2909-3
6. НұрғалиеваҚ.Е., Игенбаева Ә.С., СлəмоваӘ.Н. "Электронды аналогты құрылғыларды Multisimортасында моделдеу" зертханалық жұмыстарға әдістемелік нұсқаулықтар// Современное образование в школе, колледже и ВУЗе, Казахстан 2017 г., 37, #2 с 18 по 19
7. Боброва И.И. Информационные технологии в образовании [Электронный ресурс] : практический курс / И.И. Боброва, Е.Г. Трофимов. - 2-е изд., стер.. - Москва : Флинта, 2014. - 196 с. : ил. Полный текст находится в ЭБС “Университетская библиотека ONLINE”.
8. Информационные технологии в образовании [Электронный ресурс] : учебное пособие. - Ставрополь : СКФУ, 2014. - 102 с. Полный текст находится в ЭБС “Университетская библиотека ONLINE”.
9. https://designingoutcomes.com/english-speaking-world-v5-0

Teaching/Learning Tools

MS Office, on-line learning applications (Zoom, MS Teams, Google meet, Skype add etc), distance learning tools (Google classroom, Moodle and so on), Quiz maker applications, Engineering simulation programs (Comsol, Multisim, Mathlab, AutoCAD and so on), Antiplagiat systems, Scopus, ClarivateAnalytics.

Previous knowledge assumed as acquired

Material	Source
The basics on informational-communication technologies	Any course related to computer literacy

Teaching/Learning methodology

Training is organized on the basis of methods:

- practical;
- research;
- problem-based learning;
- developing training.

Educational technologies are used: problem-based learning technology, project-based learning technology, contextual learning technology, advanced learning technology, developmental learning technology, digital educational technologies.

Characterization of objectives and course program

A – Estimated percentage distribution of pedagogical and technological content

- Pedagogical component (establishes and develops pedagogical basis) – 35%
- Technological component (applies to design and process operation) – 65%

Characterization of objectives and course program

B – Outcomes – in conformity with EUR-ACE criteria(later on we will adjust this to the ENTER Standards)

Group of outcomes	Outcome
Knowledge and Understanding	O1 – knowledge of digitalization of education as a tool for the formation of professional and supra-professional competences, educators' digital competence
	O2 – knowledge of different types of digital resources and technologies in learning and education, methodology of their development
Organization of students' Investigations	O3 – ability to assess the quality of digital educational resources on the basis of a system-activity approach
	O4 – ability to use computer simulation in engineering
Transferable Skills	O5 – readiness to comply the rules of cyber security in digital education and develop own digital culture

III – PLANNING

COMPULSORY UNITS of the Course (including self-guided learning)	SUMMARY	OBSERVATIONS

Digitalization of education as a tool for the formation of professional and supra-professional competences. Educators' digital competence	Educators' digital competence. Levels of formation of basic competencies, methodological basis for determining professional and supra-professional competencies, soft-skills, hard-skills, educational "transition" from education for all to education for everyone	Interaction of teacher and course participants within the course. Contact hours: 3 Self-study autonomous work hours: 2 Outcome: 1
Digital resources and technologies in learning and education. The methodology for the development of digital educational resources. Features of the organization of distance education	Open digital sources of information: electronic databases, reference books, statistical reviews and others. Mass open educational courses on open education platforms. Electronic reference systems. Electronic textbook. Electronic portfolio of a student. Electronic cases. Virtual laboratory. Presentation, interactive posters, electronic textbooks, electronic education materials, distance education, electronic journal /diary Stages of development of digital educational resources. The significance of external design and development stages of a technical task. Principles of development of digital educational resources in accordance with the requirements of the system-activity approach Comparative characteristics of traditional and distance learning. Electronic educational environment as the main means of organizing distance learning. Legal, organizational, pedagogical, material and technical aspects of distance learning implementation.	Interaction of teacher and course participants within the course. Contact hours: 16 Self-study autonomous work hours: 15.25 Outcome: 2
Assessment of the quality of digital educational resources on the basis of a system-activity approach	Methods for assessing the quality of digital educational resources: expert methods, analytical methods. Purpose of quality assessment of digital educational resources. Criteria for assessing the quality of digital educational resources: sanitary-hygienic, technical-technological, didactic, ergonomic, requirements of the system-activity approach	Interaction of teacher and course participants within the course. Contact hours: 2 Self-study autonomous work hours: 0.5 Outcome: 3

Computer simulation in engineering, software for solving engineering problems.	Overview of engineering soft, possibilities of program packages, advantages and disadvantages, the using in training of students	Interaction of teacher and course participants within the course. Contact hours: 7 Self-study autonomous work hours: 1.75 Outcome: 4
The basics of cyber security in digital education. Digital technology culture.	Information security as a strategic direction of educational organization's activity. Rules of behaviour in the network. Media literacy, plagiarism, copyright protection, electronic legal reference systems	Interaction of teacher and course participants within the course. Contact hours: 2.5 Self-study autonomous work hours: - Outcome: 5

IV– ASSESSMENTPROCEDURE
Self-Assessment Provide example sheets, paper & pencil versus computer-aided worked examples Check-list, «treasure Island», sharing entrance control in the form of testing at the beginning of training to determine whether the existing students ' competencies meet the established requirements 0%;
Teacher´s Assessment The teacher fulfils: - current control in the form of group discussion 20% - intermediate control in the form of testing or/and solving cases for each module of the discipline 40%; - final control in the form of project presentation 40%.

ASSESSMENT TOOLS (ONE TABLE FOR EACH TOOL)

ASSESSMENT TOOL 1

NAME	Tool 1
TOOL TYPE	Input test
ASSESSMENT TYPE	Diagnostic
IMPLEMENTATION	Performed with the use of information technology
DESCRIPTION	Includes 10 closed questions corresponding to this learning result
CRITERIA, RUBRICS, RATING SCALES	At least 70% of correct answers

ASSESSMENT TOOL 2

NAME	Tool 2
TOOL TYPE	Group discussion
ASSESSMENT TYPE	Formative
IMPLEMENTATION	Within 15 minutes a discussion of the problem situation is held, all students express their opinion

DESCRIPTION	Analysis of the problem situation, determining the causes and finding solutions
CRITERIA, RUBRICS, RATING SCALES	Estimates: - reasonableness of the answer; - specificity of proposals; - proposals based on existing experience; - realism of the proposed solutions.

ASSESSMENT TOOL 3

NAME	Tool 3
TOOL TYPE	Test
ASSESSMENT TYPE	Summative
IMPLEMENTATION	Performed with the use of information technology
DESCRIPTION	Includes 10 closed questions for each section of the discipline. Held after each section of the discipline.
CRITERIA, RUBRICS, RATING SCALES	At least 75% of correct answers

ASSESSMENT TOOL 4

NAME	Tool 4
TOOL TYPE	Case-study
ASSESSMENT TYPE	Formative
IMPLEMENTATION	Performed in subgroups
DESCRIPTION	Each group is given a case with questions to discuss. Based on the results of the group work, a draft decision of the case should be presented.
CRITERIA, RUBRICS, RATING SCALES	The result of student's activity / Rate *The task is not done* — 0 *The task is not completed* — 1 *The decision has a controversial justification, a student didn't answer the questions* — 2 *The decision has a controversial justification, a student gave answers for all questions* — 3 *The decision has a clear justification, a student gave answers for some questions* — 4 *The decision has a clear justification, a student used a non-standard approach to the solution, a student gave answers for all questions* — 5

ASSESSMENT TOOL 5

NAME	Tool 5
TOOL TYPE	Project
ASSESSMENT TYPE	Summative
IMPLEMENTATION	Individual project activity
DESCRIPTION	Implementation of the project based on the materials of the discipline module. The students should assess the quality of a proposed digital educational resource on the basis of a system-activity approach and justify its application in educational process within academic discipline

CRITERIA, RUBRICS, RATING SCALES	The result of student's activity	Rate
	The project is not done	0
	The project is not completed	1
	The project contains a clear justification of digital resource application but there is no description of assessment of its quality, a student gave detailed answers for all questions	2
	The project contains a clear justification of digital resource application but not full description of assessment of its quality, a student gave detailed answers not for all questions	3
	The project contains a clear justification of digital resource application and qualitative description of assessment of its quality, a student gave detailed answers not for all questions	4
	The project contains a clear justification of digital resource application and qualitative description of assessment of its quality, a student gave detailed answers for all questions	5

ASSESSMENT TOOLS VERSUS OUTCOMES

TOOLS / OUTCOMES	TOOL 1	TOOL 2	TOOL 3	TOOL 4	TOOL 5
OUTCOME 1	+	+	+		+
OUTCOME 2		+	+		+
OUTCOME 3				+	+
OUTCOME 4				+	+
OUTCOME 5				+	+

ASSESSMENT: ACHIEVED LEVEL OF LEARNING OUTCOMES (TO BE FILLED DURING OR AT THE END OF THE COURSE)

OUTCOME	NOT IMPLEMENTED	ATTEMPTED IMPLEMENTATION	MANY DEFECTS	SOME DEFECTS	MINOR DEFECTS	CORRECT	EXCEPTIONAL
OUTCOME 1							
OUTCOME 2							
…							
OUTCOME N							

Levels of outcomes' achievement correspond to:

- **Exceptional**- exceeded all goals; applied knowledge to new situations and / or solved standard problems competently
- **Correct** - achieved all objectives in a minimally competent manner; applied the knowledge and skills to known standard cases
- **Minor defects** - achieved the most important goals competently; denoted some shortcomings
- **Some defects** - reached the objectives in general computation; demonstrated some weaknesses/defects
- **Many defects** - achieved only minimum goals; demonstrated many weaknesses/defects
- **Attempted Implementation** - failed to meet minimum objectives; demonstrated some skills
- **Not Implemented**- have not demonstrated a minimally significant set of skills; violated fundamental principles of engineering science / pedagogy and / or nothing minimally acceptable was produced

NOTES (PRIVATE/RESTRICTED TO THIS FORM)

NOTES (PUBLIC/TO BE AVAILABLE ONLINE)

SYLLABUS FOR COURSE 3.2. PROBLEM-BASED, PROJECT-BASED AND PRACTICE-ORIENTED LEARNING

INSTITUTION:	**TO BE FILLED LATER**
PROGRAM:	**iPET 3**
COURSE:	**3.2. PROBLEM-BASED, PROJECT-BASED AND PRACTICE-ORIENTED LEARNING**

I – IDENTIFICATION						
COMPULSORY COURSE	**CONTACT TIME - HOURS**				**SELF-STUDY - HOURS**	**CREDITS ECTS**
	LECTURES	**TUTORIALS**	**PRACTICAL /PROJECT**	**TOTAL**		
PROBLEM-BASED, PROJECT-BASED AND PRACTICE-ORIENTED LEARNING	**6**	**8**	**12**	**26**	**24**	**2**

FORMAL PREREQUISITES (IF ANY): -
COURSE WEBSITE URL: TO BE FILLED LATER

II – AIMS, SYNOPSIS, CHARACTERIZATION
Background (max. 600 characters) Modern society with high level of technological development and complex interdisciplinary engineering tasks calls for engineering education to be aimed at professional practice, to foster critical thinking, creativity, and student autonomy as well as ability to collaborate and communicate. These goals can be achieved by the implementation of problem-based and practice-oriented learning in the form of project organization, whose collaborative characteristics include incorporation of real-life situations into learning process as well as interdisciplinarity and teamwork. It is an active way of learning that gives a better retention of knowledge, enhances motivation and encourages the development of hard and soft skills that are essential for the labor market in the 21st century.
Aims – overview (max. 750 characters) The core aim of the course is to foster competences and ability of engineering educators to organize within their courses students' problem-based and practice-oriented activity in the form of projects (project works).
Specific Aims (max. 1000 characters) Problem-based learning (PBL) is widely known as a successful and innovative method for engineering education. In comparison to traditional engineering curricula, the PBL structure of curricula and educational courses enhances learning interactivity and assures students' involvement in the educational process, which, consequently, results in a higher level of complex comprehension.

Organization of such learning process, especially in the form of student projects (project works), requires from an educator an ability to apply a comprehensive approach to course design. The course aims to foster engineering educators' knowledge and skills (learning outcomes):

1. To know and understand basic definitions of problem-based learning, practice-oriented learning and project-based learning; to be familiar with the history and best practices of such learning (O1)
2. To be able to transform educational process from traditional forms to individual, dual or group independent students' activity with research and creative nature (O2)
3. O3. To understand aims of practice-oriented and problem-based learning, to know and be able to apply tools and methods for project management (O3)
4. To apply analytical, critical and creative thinking, when organizing students' analytical project work (O4)
5. To generate new ideas and guide students for finding, identifying and choosing most important and practically relevant problems and project topics (O5)
6. To plan and organize educational environment for students' collaborative work, including interdisciplinary and multidisciplinary online and offline team work and stimulate group-dynamics (O6)
7. To set aims, choose methods and organizational conditions for project realization (O7)
8. To foster students' investigation process (problem situation identification and analysis, experiment, hypothesis formulation, etc.) (O8)
9. To foster students' ability to plan, organize, monitor and control their project work, to involve students in laboratory research (O9)
10. To stimulate students to foresee results of their actions and to be responsible for them (O10)

Contents (max. 1000 characters)

A fundamental principle of problem-based, practice-oriented and project-based learning is that the students are the owners of the learning process and the facilitator guides the students by presenting various ideas with supporting methods and tools for their realization.

In the PBL curriculum, projects serve as the platform for students to foster competences, and to relate disciplines to each other in analysis and identification of problems as well as the problem-solving process. Process skills such as self-directed learning, project management, collaboration, communication, responsibility for taken decisions are taught in an integrated way by letting students reflect upon their practice (K. Edström & A. Kolmos, 2014).

This course is dedicated to fostering engineering educators' abilities to construct educational process aiming to achieve the mentioned above learning outcomes of students.

The course consists of 5 modules:

1. Course introduction – concepts, definitions, history and best practices; (4%)
2. Problem-based learning – principles, methods and tools for implementation; (20%)
3. Practice-oriented learning – forms of organization, university-industry relations; (20%)
4. Project-based learning – principles, tools, methodology and management; (42%)
5. Assessment of students' learning outcomes – individual and team assessment, self-evaluation, peer-review, expert board assessment. (14%)

Main Teaching Material

1. Kolmos, A. & Graaff, E de. (2003). Characteristics of Problem-Based Learning. International Journal of Engineering Education, 17(5), pp. 657–662
2. Using Project-Based Learning at an Engineering University. Manual by Pavlova I.V., Shageeva F.T., Khatsrinova O.Yu., Sanger Ph.A., Suntsova M.S. In 2 partsa, in Russian and in English. – Kazan: Printing and Publishing Center «School». 2019. - 223 pp.
3. Nilson, L. B. (2010). Teaching at its best: A research-based resource for college instructors (2nd ed.). San Francisco, CA: Jossey-Bass.
4. Kristina Edström & Anette Kolmos (2014) PBL and CDIO: complementary models for engineering education development, European Journal of Engineering Education, 39:5, 539-555, DOI: 10.1080/03043797.2014.895703
5. Anabela C. Alves, Rui M. Sousa, Sandra Fernandes, Elisabete Cardoso, Maria Alice Carvalho, Jorge Figueiredo & Rui M.S. Pereira (2016) Teacher's experiences in PBL: implications for practice, European Journal of Engineering Education, 41:2, 123-141, DOI: 10.1080/03043797.2015.1023782

In Russian:

6. Starodubtsev V.A., Minin M.G., Kostyukova T.A., Veryaev A.A. Problem-oriented and project-based learning in educational activities. Tomsk: Publishing House of TSU, 2017. 144 p. [Стародубцев В.А., Минин М.Г., Костюкова Т.А., Веряев А.А. Проблемно-ориентированное и проектно-организованное обучение в образовательной деятельности. Томск: Изд. Дом ТГУ, 2017. 144 с.]

Complementary Teaching Material

1. Duch, B. J., Groh, S. E, & Allen, D. E. (Eds.). (2001). The power of problem-based learning. Sterling, VA: Stylus
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12. Kleshcheva N.A., Shtager Ye.V. METHODOLOGICAL BASE OF DESIGNING THE INTERDISCIPLINARY EDUCATIONAL TECHNOLOGIES / Pacific Science Review. 2007. T. 9. № 2. P. 167-170.
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15. Pakhomova N.Yu. Method of study project in educational organization : guidebook for teachers and students of pedagogical universities. Moscow : ARKTI, 3rd edition, 2005. 112 p. [Пахомова Н.Ю. Метод учебного проекта в образовательном учреждении : пособие для учителей и студ. педаг. вузов. 3-е изд. М. : АРКТИ, 2005. 112 с.]

Teaching/Learning Tools

No specific tools are required, if the course is executed in an offline format.
For project management it is proposed to use the service:
https://www.projectmanager.com/google

Previous knowledge assumed as acquired

Material	Source
-	-

Teaching/Learning methodology

- Problem-based teaching & learning
- Practice-oriented teaching & learning
- Project-based teaching & learning (Student Team Learning, Cooperative Learning, Learning Together, etc.)
- Case-study and creative brain-storm
- Team work and collaboration
- Expert seminar for problem situation assessment
- Foresight

Characterization of objectives and course program

A – Estimated percentage distribution of pedagogical and technological content

- Pedagogical component (establishes and develops pedagogical basis) – 40 %
- Technological component (applies to design and process operation) – 60 %

Characterization of objectives and course program
B – Outcomes – in conformity with EUR-ACE criteria (later on we will adjust this to the ENTER Standards)

Group of outcomes	Outcome
Knowledge and Understanding	O1, O2, O3
Organization of students' Engineering Analysis	O4, O5
Organization of students' Engineering Design	O6, O7
Organization of students' Investigations	O8
Organization of students' Engineering Practice	O9
Transferable Skills	O10

III – PLANNING

COMPULSORY UNITS of the Course (including self-guided learning)	SUMMARY	OBSERVATIONS
1. Course introduction	• Concepts of problem-based, project-based and practice-oriented learning • Best practices of problem-based, project-based and practice-oriented learning	Lectures – 2 h Learning outcome: O1
2. Problem-based learning (PBL)	• Methods and tools for problem identification and formulation • PBL curriculum design • PBL & CDIO: differences and similarities • Problem-based teaching methods and tools	Lectures – 1 h Tutorials – 2 h Project work – 3 h Self-study – 4 h Learning outcomes: O2, O3, O4, O5, O8, O9
3. Practice-oriented learning	• Interaction with real sector of economy for finding project ideas • Development of project ideas pool • Forms of practice-oriented learning: learning based on experience, dual education, employers' workshops, etc.	Lectures – 1 h Tutorials – 2 h Project work – 3 h Self-study – 4 h Learning outcomes: O2, O3, O4, O5, O8
4. Project-based learning	• Projects as a form of problem-based and practice-oriented learning • Principles of project-based learning	Lectures – 1 h Tutorials – 3 h Project work – 5 h Self-study – 12 h

	• Project management tools • Organization of students' project-based learning: – Discussion and choice of project idea, topic and aim – Structuring of a project (project objectives) – Formation of creative student teams – Project planning (tasks for teams, research methods, timeline, resources, etc.) – Evaluation of impacts and risks of a project (social, ecological, economic, etc.) – Project management and monitoring of intermediate results – Presentation of project results, reflection	Learning outcomes: O2, O4, O6, O7, O8, O9, O10
5. Assessment of students' learning outcomes	• Tools for monitoring and final assessment of students' individual and group project work • Students' self-assessment and peer-review	Lectures – 1 h Tutorials – 1 h Project work – 1 h Self-study – 4 h Learning outcome: O10

IV – ASSESSMENT PROCEDURE

Self-Assessment

Self-assessment is realized in two stages: diagnostic and summative self-assessment. The tasks for these assessments are identical. Comparison of the initial and final results should underline the achieved learning outcomes of the course.

The initial and the final assessments consist of 2 tasks and aim to assess:

1. Ability to propose topics for problem-based and practice-oriented learning within own engineering courses;
2. Ability to construct the order of project stages for students' project-based learning.

Self-assessment does not impact the course evaluation.

Teacher´s Assessment

Intermediate assessment

Modules "Problem-based learning" and "Practice-oriented learning" should result in preparation of 2 mini-projects aimed at introduction of these concepts to educators' courses or their units.

Mini-projects should be assessed by course teacher and peers.

Final assessment

Modules "Project-based learning" and "Assessment of students' learning outcomes" should result in preparation of an individual or group project aimed at transformation of educators' course syllabuses by application of problem-based, practice-oriented and project-based learning.

Final projects should be assessed by an independent expert board (faculty qualified in PBL, relevant industry representatives, other stakeholders).

Weight of assessment tools: mini-project 1 – 25 %, mini-project 2 – 25 %, final project – 50 %

ASSESSMENT TOOLS (ONE TABLE FOR EACH TOOL)

ASSESSMENT TOOL 1

NAME	Introductory self-assessment
TOOL TYPE	Survey
ASSESSMENT TYPE	Diagnostic
IMPLEMENTATION	The task is executed in the beginning of the course for the purpose of future comparison with final self-assessment
DESCRIPTION	The task consists of two open questions, where students are asked to: 1. Propose topics for problem-based and practice-oriented learning within their own engineering courses; 2. Propose project stages and construct their order for students' project-based learning.
CRITERIA, RUBRICS, RATING SCALES	No assessment scale is used.

ASSESSMENT TOOL 2

NAME	Final self-assessment
TOOL TYPE	Survey
ASSESSMENT TYPE	Summative
IMPLEMENTATION	The task is executed at the end of the course for the purpose of comparison with the initial self-assessment results
DESCRIPTION	The task consists of two open questions, where students are asked to: 1. Propose topics for problem-based and practice-oriented learning within their own engineering courses; 2. Propose project stages and construct their order for students' project-based learning.
CRITERIA, RUBRICS, RATING SCALES	Evaluation is based on comparison of quality and broadness of responses in the initial and the final self-assessment.

ASSESSMENT TOOL 3

NAME	Mini-project on problem-based learning
TOOL TYPE	Project development and presentation
ASSESSMENT TYPE	Formative & summative
IMPLEMENTATION	Presentation of individual project at the end of the corresponding course unit
DESCRIPTION	Students will have to propose ways to introduce problem-based learning to their engineering courses, including identifying problem situations, methods and tools for PBL

CRITERIA, RUBRICS, RATING SCALES	Mini-project evaluation: 1. Applicability of the problem-based course/unit structure (20%) 2. Applicability of proposed methods and tools (20%) 3. Topicality and relevance of problem situations (20%) 4. Quality of presentation (20%) 5. Quality and soundness of responses (20%) Each criterion is evaluated on a scale of 1-5, where 1 – very low; 2 – low; 3 – average; 4 – above average and 5 – high.

ASSESSMENT TOOL 4

NAME	Mini-project on practice-oriented learning
TOOL TYPE	Project development and presentation
ASSESSMENT TYPE	Formative & summative
IMPLEMENTATION	Presentation of individual project at the end of the corresponding course unit
DESCRIPTION	Students will have to propose ways to organize practice-oriented learning within their engineering courses, including creating a list of practical project ideas, choosing specific forms of teaching, finding connections with real sector of economy
CRITERIA, RUBRICS, RATING SCALES	Mini-project evaluation: 1. Applicability of practice-oriented course/unit structure (20%) 2. Applicability of proposed forms of teaching (20%) 3. Topicality and relevance of project ideas (20%) 4. Quality of presentation (20%) 5. Quality and soundness of responses (20%) Each criterion is evaluated on a scale of 1-5, where 1 – very low; 2 – low; 3 – average; 4 – above average and 5 – high.

ASSESSMENT TOOL 5

NAME	Final project
TOOL TYPE	Project development and presentation
ASSESSMENT TYPE	Formative & summative
IMPLEMENTATION	Presentation of individual or group project at the end of the course
DESCRIPTION	Students will have to prepare and present a transformed course syllabus with organization of teaching and learning process in a form of a project (or projects), identifying clear teaching goals, means for organization of educational environment, tools for monitoring and assessment of study projects within their course.

CRITERIA, RUBRICS, RATING SCALES	Final project evaluation: 1. Applicability of proposed course structure (15%) 2. Applicability of proposed methods, forms of teaching and tools (15%) 3. Topicality and relevance of project ideas (15%) 4. Consistency of course aims, expected learning outcomes and teaching methods & tools (15%) 5. Relevance of proposed assessment procedure (15%) 6. Quality of presentation (15%) 7. Quality and soundness of responses (10%) Each criterion is evaluated on a scale of 1-5, where 1 – very low; 2 – low; 3 – average; 4 – above average and 5 – high.

ASSESSMENT TOOLS VERSUS OUTCOMES

TOOLS / OUTCOMES	TOOL 1	TOOL 2	TOOL 3	TOOL 4	TOOL 5
OUTCOME 1	n/a		X	X	X
OUTCOME 2	n/a		X	X	X
OUTCOME 3	n/a		X	X	X
OUTCOME 4	n/a	X	X	X	X
OUTCOME 5	n/a	X	X	X	X
OUTCOME 6	n/a		X	X	X
OUTCOME 7	n/a				X
OUTCOME 8	n/a		X	X	X
OUTCOME 9	n/a	X			X
OUTCOME 10	n/a		X	X	X

ASSESSMENT: ACHIEVED LEVEL OF LEARNING OUTCOMES (TO BE FILLED DURING OR AT THE END OF THE COURSE)

OUTCOME	NOT IMPLEMENTED	ATTEMPTED IMPLEMENTATION	MANY DEFECTS	SOME DEFECTS	MINOR DEFECTS	CORRECT	EXCEPTIONAL
OUTCOME 1							
OUTCOME 2							
…							
OUTCOME N							

Levels of outcomes' achievement correspond to:

- **Exceptional** - exceeded all goals; applied knowledge to new situations and / or solved standard problems competently
- **Correct** - achieved all objectives in a minimally competent manner; applied the knowledge and skills to known standard cases
- **Minor defects** - achieved the most important goals competently; denoted some shortcomings
- **Some defects** - reached the objectives in general computation; demonstrated some weaknesses/defects

- **Many defects** - achieved only minimum goals; demonstrated many weaknesses/defects
- **Attempted Implementation** - failed to meet minimum objectives; demonstrated some skills
- **Not Implemented** - have not demonstrated a minimally significant set of skills; violated fundamental principles of engineering science / pedagogy and / or nothing minimally acceptable was produced

NOTES (PRIVATE/RESTRICTED TO THIS FORM)

NOTES (PUBLIC/TO BE AVAILABLE ONLINE)

SYLLABUS FOR COURSE 3.3. LEARNING OUTCOMES' ASSESSMENT

INSTITUTION:	**TO BE FILLED LATER**
PROGRAM:	**iPET 3**
COURSE:	**3.3 LEARNING OUTCOMES' ASSESSMENT**

I – IDENTIFICATION						
COMPULSORY COURSE	**CONTACT TIME - HOURS**				**SELF-STUDY - HOURS**	**CREDITS ECTS**
	LECTURES	**TUTORIALS**	**PRACTICAL /PROJECT**	**TOTAL**		
LEARNING OUTCOME´S ASSESSMENT	**10**	**5**	**10**	**25**	**25**	**2**

FORMAL PREREQUISITES (IF ANY): NONE
COURSE WEBSITE URL: TO BE FILLED LATER

II – AIMS, SYNOPSIS, CHARACTERIZATION

Background (max. 600 characters)

In the case of growth of requirements to the quality of training of technical students, the requirements for modern means of assessment of their learning outcomes are also growing. The levels of students' educational progress, determined by means of control and measurement tools, are considered an indicator of how well students are engaged. Teachers' knowledge of the assessment system is an important component of organization of educational process in a university. Therefore, the assessment mission is so significant that even while planning content, style, methods and depth of training the optimal means of assessment should be determined.
The discipline is a system-forming component in the process of improving the pedagogical skills of a university teacher.

Aims – overview (max. 750 characters)

The course is aimed to prepare an educator to use a variety of types and methods of assessing learning outcomes. The goals of the discipline are:

- to provide educators with the information about scientific, methodological and regulatory bases of the procedures for monitoring and assessing learning outcomes;
- to explain the importance of assessment in educational process of a technical university to ensure the quality of engineering education;
- to improve the level of methodological competencies related to the development of assessment tools for intermediate attestation within academic disciplines and interdisciplinary courses as part of professional modules.

The aim of the course is to provide knowledge in the field of assessment of learning outcomes, focusing on the importance, evaluation functions, methods and forms of examination and evaluation, and current trends in examining and evaluating of students. At the end of the course, engineering educators will be able to use the acquired knowledge creatively in teaching practice.

Specific Aims (max. 1000 characters)

The specific aims of the course are:
O1 To explain the methodological basis for assessing the quality of learning outcomes; types and methods of assessment of learning outcomes; features of organization of current, intermediate and final quality control within an academic discipline,
O2 To create assessment tools for current and intermediate evaluation within academic disciplines; to use various methods of assessing the quality of knowledge and skills in the process of current, intermediate and final control,
O3 To use assessment tools and methods for assessing the quality of education; to realize independent and group project activities.

Contents (max. 1000 characters)

The course consists of following modules:

1. Methodology of learning outcomes' assessment. Properties of assessment. Functions of assessment. The legal framework for the assessment of quality in education. Heutagogy (2,5 hrs, 10 %)
2. Types and methods of assessment in modern education. Criteria of successful assessment. Assessment of skills in engineering education. Requirements for tests in specialized disciplines. Self-checking. Feedback. Check list (7,5 hrs, 30 %)
3. Features of organization of current quality control (5 hrs, 20 %)
4. Methods of assessment tools development for students' intermediate attestation (5 hrs, 20 %)
5. Assessment of graduates' results in the process of final attestation (5 hrs, 20 %)

Main Teaching Material

1. Гордиенко, О. В. Современные средства оценивания результатов обучения: учебник для академического бакалавриата / О. В. Гордиенко. — 2-е изд., испр. и доп. — Москва: Издательство Юрайт, 2019. — 177 с. — (Высшее образование). — ISBN 978-5-534-06396-7. URL: https://urait.ru/bcode/438064
2. Звонников, В.И. Современные средства оценивания результатов обучения [Текст] : учеб. пособие для студ. вузов, обучающихся по пед. спец. / В. И. Звонников, М. Б. Челышкова. - 3-е изд., стер. - М.: Академия, 2009. - 224 с.
3. Звонников, В. И. Оценка качества результатов обучения при аттестации (компетентностный подход) [Электронный ресурс] : учеб. пособие / В. И. Звонников, М. Б. Челышкова. - 2-е изд., перераб. и доп. - М.: Логос, 2012. - 280 с. - ISBN 978-5-98704-623-4. - Режим доступа: http://znanium.com/catalog/product/468732
4. Goff, L. et. al. Learning Outcomes Assessment: A practitioner´s handbook. Higher Education Quality Council of Ontario. http://www.heqco.ca/SiteCollectionDocuments/heqco.LOAhandbook_Eng_2015.pdf
5. CEDEFOP. Defining, writing and applying learning outcomes. A European handbook. Luxembourg : Publications Office of the European Union, 2017. ISBN 978-92-896-2481-7.

Complementary Teaching Material

1. Виневская, А. В. Метод кейсов в педагогике [Текст]: практикум для учителей и студентов / А. В. Виневская. - Ростов н/Д : Феникс, 2015. - 141 с.
2. Гордиенко, О. В. Современные средства оценивания результатов обучения. Практикум: учебное пособие для академического бакалавриата / О. В. Гордиенко.

— Москва: Издательство Юрайт, 2018. — 115 с. — ISBN 978-5-534-07128-3. — Текст: электронный // ЭБС Юрайт [сайт]. — URL: https://urait.ru/index.php/bcode/423371 (дата обращения: 11.01.2020).
3. Касаткина, Н. Э. Современные средства оценивания результатов обучения [Электронный ресурс]: учебное пособие / Н.Э. Касаткина. - Кемерово: Кемеровский государственный университет, 2010. - 204 с.
4. Чернявская, А.П., Гречин, Б.С. Современные средства оценивания результатов обучения [Текст]: учебно-методическое пособие. – Ярославль : Изд-во ЯГПУ. – 2008. – 98 с. Режим доступа: http://pedte.narod.ru/SSORO_Uchebnik.html
5. Журнал «Образовательные технологии» Режим доступа: https://elibrary.ru/
6. Журнал «Высшее образование сегодня» Режим доступа: https://elibrary.ru/
7. Журнал «Вопросы современной науки и практики. Университет имени В.И. Вернадского» Режим доступа: https://elibrary.ru/, http://vernadsky.tstu.ru/ru
8. Электронный журнал «Высшее образование в России» Режим доступа: https://elibrary.ru/
9. Электронный журнал «Almamater. Вестник высшей школы» Режим доступа: https://elibrary.ru/
10. Компетентностно-ориентированная система оценки знаний (44 ; 2014 ; Алматы). Материалы 44-й научно-методической конференции, 17-18 янв. 2014 г. ("Білімді бағалаудың құзыретті-бағдарлы жүйесі" : сборник. Кн. 2 / КазНУ им. аль-Фараби;) - Алматы : Қазақ ун-ті, 2014. - 361, [1] с. - ISBN 978-601-04-0272-0

Teaching/Learning Tools
MS Office, Mentimeter.com, Kahoot

Previous knowledge assumed as acquired

Material	**Source**
Basic knowledge of didactics	Previous study (secondary school, university, courses)
The concept of assessing the quality of knowledge and skills	Previous study
Professional and educational standards	Previous study

Teaching/Learning methodology
Teaching in the course is based primarily on the method of interpretation, the method of interview, cooperative teaching, problem teaching, independent work, practical; research; problem-based learning; developing training. The course is realized so that after end of the course, participants will be able to creatively use the acquired knowledge in teaching practice. Educational technologies are used: problem-based learning technology, project-based learning technology, contextual learning technology, advanced learning technology, developmental learning technology, digital educational technologies.
The teacher applies TQM (Total Quality Management) elements important for the quality of the teaching process:
- focus on the satisfaction of the partners - participants of the course (finding out students' preferences, evaluating the quality of the teaching unit),

- focus on the learning process (focus on the quality of the learning process - applying the latest information, trends, innovation; providing feedback),
- continuous improvement - improvement of the teaching process, application of a systematic approach of the PDCA cycle,
- creating a favourable climate (culture) in the teaching process of the course.

Characterization of objectives and course program
A – Estimated percentage distribution of pedagogical and technological content

- Pedagogical component (establishes and develops pedagogical basis) – 55 %
- Technological component (applies to design and process operation) – 45 %

Characterization of objectives and course program
B – Outcomes – in conformity with EUR-ACE criteria (later on we will adjust this to the ENTER Standards)

Group of outcomes	**Outcome**
Knowledge and Understanding	O1
Organization of students' Investigations	O2, O3
Transferable Skills	O2, O3

III – PLANNING

COMPULSORY UNITS of the Course (including self-guided learning)	**SUMMARY**	**OBSERVATIONS**
Methodology of learning outcomes' assessment. Properties of assessment. Functions of assessment. The legal framework for the assessment of quality in education. Heutagogy	The essence of the quality of learning outcomes. The main concepts related to the quality of learning outcomes (quality of education, professional competence, educational outcomes, assessment levels, assessment criteria, assessment procedures, levels of achievement of learning outcomes). Approaches to assessing the quality of learning outcomes. Assessment functions: normative, control (diagnostic), prognostic, motivational, educational, informative, developing and feedback. Professional standards, educational standards: essence, structure, requirements. Application of different standards for assessing the quality of learning outcomes: national, international. The principles of assessment. The legal framework for the assessment of quality in education	Interaction o teacher and course participants within the course. Contact hours: 2,5 Self-study/autonomous work hours: 2,5 Outcomes: 1

Types and methods of assessment in modern education. Eight criteria of successful assessment. Assessment of skills in engineering education. Requirements for tests in specialized disciplines. Self-checking. Feedback. Check list	Types of education quality assessment: - internal: input control, current control, intermediate control, final control; - external: state control, demo exam, independent quality assessment, assessment of students ' residual knowledge, state accreditation and professional-public accreditation. National and international systems for assessing the quality of education. Assessment systems: - point-rating; - public assessment; - module-rating; - WorldSkills examination; - independent assessment. Methods and forms of examination - according to the way of expression, according to the number of students, according to time and function. Assessment methods: - testing; - survey; - implementation of projects; - essay; - solving cases; - solving problem tasks of different levels; - implementation of practical tasks; - competitions in professional skills; - methods of expert assessment and others. Didactic test. Basic concepts, classification and advantages of didactic tests. Construction of didactic tests. Solution, correction and classification of didactic tests Assessment methods and forms - distinguishing; verifying; individualized; continuous and final; formative and summative, formal and informal; assessment of the course of activity, assessment of the result of the activity. Eight criteria of successful assessment. Assessment of skills in engineering education. Requirements for tests in specialized disciplines. The concept and function of self-assessment. Types of self-assessment. Techniques for self-evaluation Self-assessment form, reflexive writing and other techniques. Providing feedback as a component of assessment of the quality of learning outcomes. A check-list.	Interaction o teacher and course participants within the course. Contact hours: 7,5 Self-study/autonomous work hours: 7,5 Outcomes: 1
Features of organization of current quality control	The value of current control. The place of current control in the assessment of the quality of education. Methods of carrying out current control. Forms and procedures of current control. Fixing the results of current control. Student’s self-assessment of learning outcomes as a component of ongoing quality control of education.	Interaction o teacher and course participants within the course. Contact hours: 5

		Self-study/autonomous work hours: 5 Outcomes: 1
Methodics of assessment tools development for students' intermediate attestation	Current trends in student examination and assessment (different methods of examination and assessment, portfolio, authentic teaching and authentic assessment, verbal assessment, observation, principles of humanistic assessment). Features of development of various types of assessment tools: - tests of various types; - questionnaires; - practical tasks; - cases; - questions for group discussions; - project tasks and others. Definition of assessment parameters and description of an assessment procedure. Shortcomings in examination and assessment. Recommendations for increasing the efficiency of examinations and students assessments	Interaction o teacher and course participants within the course. Contact hours: 5 Self-study/autonomous work hours: 5 Outcomes: 1
Assessment of graduates' results in the process of final attestation	Features of the organization of students' final attestation. Forms of final attestation. Procedures for conducting final attestation. Final practical qualification work and written examination work, diploma project, demonstration exam using the WorldSkills method.	Interaction o teacher and course participants within the course. Contact hours: 5 Self-study/autonomous work hours: 5 Outcomes: 1

IV – ASSESSMENT PROCEDURE
Self-Assessment Self-assessment form
Teacher´s Assessment The teacher fulfils: - current control in the form of practical tasks and group discussion; - intermediate control in the form of testing and solving cases for each module of the discipline; - final control in the form of project presentation. Practical task 20 % Group discussion 10 % Case study 20 % Project 50 %

ASSESSMENT TOOLS (ONE TABLE FOR EACH TOOL)

ASSESSMENT TOOL 1

NAME	Tool 1
TOOL TYPE	Practical task
ASSESSMENT TYPE	Formative
IMPLEMENTATION	Solving practical tasks
DESCRIPTION	When performing practical tasks, a student must demonstrate: - skills to develop assessment tools; - skills to use different assessment methods.
CRITERIA, RUBRICS, RATING SCALES	

The result of student's activity	Rate
The task is not done	0
The task is not completed	1
When performing the task, fundamental mistakes were made in the use of assessment tools and methods	2
The task is completed, but there are small mistakes in the reasoning and using assessment tools and methods	3
The task is completed	4
The task is completed, the knowledge of the psychological features of the organization of the educational process is shown	5

ASSESSMENT TOOL 2

NAME	Tool 2
TOOL TYPE	Group discussion
ASSESSMENT TYPE	Formative
IMPLEMENTATION	Within 15 minutes a discussion of the problem situation is held, all students express their opinion
DESCRIPTION	Analysis of the problem situation, determining the causes and finding solutions
CRITERIA, RUBRICS, RATING SCALES	Estimates: - reasonableness of the answer; - specificity of proposals; - proposals based on existing experience; - realism of the proposed solutions.

ASSESSMENT TOOL 3

NAME	Tool 3
TOOL TYPE	Case study
ASSESSMENT TYPE	Formative
IMPLEMENTATION	Performed in subgroups
DESCRIPTION	Each group is given a case with questions to discuss. Based on the results of the group work, a draft decision of the case should be presented.
CRITERIA, RUBRICS, RATING SCALES	

The result of student's activity	Rate
The task is not done	0
The task is not completed	1
The decision has a controversial justification, a student didn't answer the questions	2
The decision has a controversial justification, a student gave answers for all questions	3
The decision has a clear justification, a student gave answers for some questions	4
The decision has a clear justification, a student used a non-standard approach to the solution, a student gave answers for all questions	5

ASSESSMENT TOOL 4

NAME	Tool 4
TOOL TYPE	Project

ASSESSMENT TYPE	Summative
IMPLEMENTATION	Individual project activity
DESCRIPTION	Development of a system of assessment tools taking into account all types of quality control within the discipline taught
CRITERIA, RUBRICS, RATING SCALES	

The result of student's activity	Rate
The task is not done	0
The task is not completed	1
The project contains a set of assessment tools for 2 types of control, but a student gave answers not for all questions	2
The project contains a set of assessment tools for 2 types of control, a student answered all questions	3
The project contains a set of assessment tools for 3 types of control, a student gave detailed answers for all questions	4
The project contains a complete set of assessment tools for all types of control, a student gave detailed answers for all questions	5

ASSESSMENT TOOLS VERSUS OUTCOMES

TOOLS / OUTCOMES	TOOL 1 PRACTICAL TASK	TOOL 2 GROUP DISCUSSION	TOOL 3 CASE STUDY	TOOL 4 PROJECT
OUTCOME 1	x	x		x
OUTCOME 2	x		x	x
OUTCOME 3	x	x	x	x

ASSESSMENT: ACHIEVED LEVEL OF LEARNING OUTCOMES (TO BE FILLED DURING OR AT THE END OF THE COURSE)

OUTCOME	NOT IMPLEMENTED	ATTEMPTED IMPLEMENTATION	MANY DEFECTS	SOME DEFECTS	MINOR DEFECTS	CORRECT	EXCEPTIONAL
OUTCOME 1							
OUTCOME 2							
…							
OUTCOME N							

Levels of outcomes' achievement correspond to:

- **Exceptional** - exceeded all goals; applied knowledge to new situations and / or solved standard problems competently
- **Correct** - achieved all objectives in a minimally competent manner; applied the knowledge and skills to known standard cases
- **Minor defects** - achieved the most important goals competently; denoted some shortcomings
- **Some defects** - reached the objectives in general computation; demonstrated some weaknesses/defects
- **Many defects** - achieved only minimum goals; demonstrated many weaknesses/defects

- **Attempted Implementation** - failed to meet minimum objectives; demonstrated some skills
- **Not Implemented** - have not demonstrated a minimally significant set of skills; violated fundamental principles of engineering science / pedagogy and / or nothing minimally acceptable was produced

NOTES (PRIVATE/RESTRICTED TO THIS FORM)

NOTES (PUBLIC/TO BE AVAILABLE ONLINE)

SYLLABUS FOR COURSE 3.4. COURSE DESIGN

INSTITUTION:	**TO BE FILLED LATER**
PROGRAM:	**iPET 3**
COURSE:	**3.4. COURSE DESIGN**

I – IDENTIFICATION						
COMPULSORY COURSE	**CONTACT TIME – HOURS**				**SELF-STUDY - HOURS**	**CREDITS ECTS**
	LECTURES	**TUTORIALS**	**PRACTICAL /PROJECT**	**TOTAL**		
COURSE DESIGN	**6**	**6**	**6**	**18**	**7**	**1**

FORMAL PREREQUISITES (IF ANY):

COURSE WEBSITE URL: TO BE FILLED LATER

II – AIMS, SYNOPSIS, CHARACTERIZATION

Background (max. 600 characters)
This course supports engineering educators' ability to design effective course syllabi fostering the formation of students' competences within specific disciplines using classroom activities and blended learning. Whether designing a new course or renewing an existing one, engineering educators will have to define clearly what they expect their students will learn (what knowledge, skills and values will they acquire) by the end of the course. In the interaction of engineering pedagogical theory and teaching methodology practice, they develop the core competencies for planning, performing and evaluating the process of teaching and learning.

Aims – overview (max. 750 characters)
Engineering educators expand their engineering subject competence with teaching and learning competences in the field of Engineering Pedagogy Science (especially educational, teaching and evaluative competences) in theory and practice. Engineering Pedagogy didactical models assist for the design of higher level course aims and learning outcomes supporting creative and critical thinking, designing motivating learning environment taking account of learners' individual differences, selection of the content, and effective methodology of teaching, learning and assessment – to name but a few of the basic principles of contemporary course design. The general aim of the course is to support engineering educators in the design of process of effective teaching and learning, design class activities and create a learning-centred syllabus.

Specific Aims (max. 1000 characters)
Having passed the course engineering educators will be able to:

- O1. Design the aims and learning outcomes of the course for critical thinking and higher level learning, taking account of didactical models of Engineering Pedagogy Science;
- O2. Design and analyse the process of teaching and learning based on contemporary learning theories and the basic principles of Engineering Pedagogy Science;
- O3. Activate students, taking account of their individual differences for learning-centred interactive teaching;
- O4. Design didactically effective learning materials and course content;

- O5. Design motivating learning environment and select relevant contemporary teaching technology;
- O6. Select effective teaching methodology;
- O7. Manage and develop effective process of motivating assessment and feedback;
- O8. Analyse and reflect on the process of teaching and learning for the further improvement.

Contents (max. 1000 characters)

- Goals and learning outcomes. Terminology. Principles of didactics.
- Basic concepts of Engineering Pedagogy. The basic didactical model of Engineering Pedagogy Science for course design. Didactical models in Engineering Pedagogy for the design of teaching goals and learning outcomes for higher-level learning and critical thinking (Bloom, Feisel-Schmitz, Dee Fink, Plants, Domin, Hmelo-Silver, Harrow, Hauenstein etc).
- Learning theories as the basis of effective course design.
- Design of the course content and learning materials.
- Motivating and supportive learning environment. Teaching technology.
- Students' individual differences. Learning styles. Motivation and self-regulation.
- Active learning and collaborative work.
- Teaching and learning methodology - teaching models, methods and strategies. Lesson models and analysis. Managing and developing effective process of teaching and learning in Learning Management System. CDIO.
- Laboratory didactics. Team-based learning.
- Assessment and feedback methods.
- Reflection and analysis of teaching and learning. Reflection models (Korthagen, Gibbs, onion model, mentoring model etc).

Main Teaching Material

1. Wankat P.C., Oreovicz F.S. (2016). Teaching Engineering. Purdue University Press; 2 edition
2. Edstrom K., Crawley E.F., Ostlund S., Malmqvist J. (2016). Rethinking Engineering Education: The CDIO Approach. 2nd ed. Springer International Publishing AG
3. Felder Richard M., Brent Rebecca (2016). Teaching and Learning STEM – A Practical Guide. Jossey-Bass, A Wiley Brand.
4. Biggs J. B., Tang C. (2011). Teaching for Quality Learning at University: What the Student Does, 4th edition, Open University Press
5. Burden P. R., Byrd D. M. (2018). Methods for Effective Teaching: Meeting the Needs of All Students 8th edition. Pearson
6. McKeachie W., Svinicki M. (2013). McKeachie's Teaching Tips, International Edition 14th Revised edition, Wadsworth Publishing Co Inc
7. https://teachingcommons.stanford.edu/resources/course-preparation-resources/course-preparation-handbook/course-design
8. Declan Kennedy (2007). Writing and Using Learning Outcomes: A Practical Guide., Quality Promotion Unit, UCC https://www.cmepius.si/wp-content/uploads/2015/06/A-Learning-Outcomes-Book-D-Kennedy.pdf

Complementary Teaching Material

1. Borich G.D. (2016). Effective Teaching Methods: Research-Based Practice, Pearson
2. Kauchak D., Eggen P. (2018). Introduction to Teaching: Becoming a Professional 6th edition, Pearson

3. Fashant Z., Ross S., Russell L., LaPlant K.P., Jacobson J., Hutchinson S., Fink L.D. (2019), Designing Effective Teaching and Significant Learning, Stylus Publishing
4. Hénard F., Roseveare D (2012). Fostering Quality Teaching in Higher Education: Policies and Practices. Institutional Management in Higher Education. Guide for Higher Education Institutions. http://www.oecd.org/edu/imhe/QT%20policies%20and%20practices.pdf
5. Kalman C.S. (2018). Successful Science and Engineering Teaching: Theoretical and Learning Perspectives 2nd ed, Springer International Publishing AG
6. A learning management system (LMS). https://en.wikipedia.org/wiki/Learning_management_system

Teaching/Learning Tools

MS Teams. Zoom platform. White Boards. Google Docs. Moodle BigBlueButton.

- Socrative - https://socrative.com/
- Classtime - https://www.classtime.com/en/
- Kahoot! - https://create.kahoot.it/login
- Quizizz – https://quizizz.com/
- Poll Everywhere - https://www.polleverywhere.com/
- Quizzwhizzer - https://quizwhizzer.com/
- Answer Garden - https://answergarden.ch/
- Triventy - http://www.triventy.com/
- Quizlet - https://quizlet.com/
- Plickers – https://get.plickers.com/
- Mentimeter - https://www.mentimeter.com
- Padlet - https://padlet.com/
- Tricider - https://www.tricider.com
- Stormboard - https://stormboard.com/
- Etc.

Previous knowledge assumed as acquired

Material	**Source**
Knowledge in engineering specialty that will be taught by the educator	Engineering education on at least MSc level

Teaching/Learning methodology

- Learning-centred and interaction-centred teaching.
- Contemporary and a range of various teaching methods used: interactive lectures with active breaks (with interaction and discussions, answering questions, solving problems etc.), seminars, collaborative exercises, active learning including team-based learning, integrative learning, group work and experiential learning.
- Interaction between instructors and students, as well as collaboration among students is emphasized.
- E-learning and blended learning, flipped and hybrid classroom.
- Active and interactive learning methods. Some examples could be found and selected under the link: https://www.uky.edu/celt/50-classroom-assessment-techniques-cats

Characterization of objectives and course program

A – Estimated percentage distribution of pedagogical and technological content

- Pedagogical component (establishes and develops pedagogical basis) – 70 %

- Technological component (the use of learning technology and apps) – 30 %

Characterization of objectives and course program
B – Outcomes – in conformity with EUR-ACE criteria (later on we will adjust this to the ENTER Standards)

Group of outcomes	Outcome
Knowledge and Understanding	O1, O2
Organization of students' Engineering Analysis	O1, O2, O4, O8
Organization of students' Engineering Design	O1, O2, O4, O5
Organization of students' Investigations	
Organization of students' Engineering Practice	O3, O6
Transferable Skills	O2, O3, O7, O8

III – PLANNING

COMPULSORY UNITS of the Course (including self-guided learning)	**SUMMARY**	**OBSERVATIONS**
Basic principles of the course design (8%)	Introduction to the course design. Basic concepts of STEM didactics and Engineering Pedagogy Science. Goals and learning outcomes. The basic didactical model of Engineering Pedagogy Science for course design. Terminology. Principles of didactics	Interaction of teacher and participants, group work, discussions Interactive lecture (1 hr), tutorial (1 hr), active learning methods selected under the link: https://www.uky.edu/celt/50-classroom-assessment-techniques-cats Learning outcomes: O1, O2 *Estimated time presented, as active learning is used, the time may be changed in all units*
Design of aims and outcomes (8%)	Design of the process of effective teaching and learning in teaching engineering for supporting higher level and critical thinking. Didactical models in Engineering Pedagogy for designing aims and outcomes (Bloom, Feisel-Schmitz, Dee Fink, Plants, Domin, Hmelo-Silver, Harrow, Hauenstein etc). Learning theories. Course content.	Group activities, active learning Tutorial (1 hr), interactive lecture (1 hr) Learning outcomes: O2, O4
Laboratory didactics and teaching technology (12%)	Laboratory didactics. Team-based learning. Critical thinking and higher level thinking skills. Motivating and supportive learning environment. Teaching technology. Use of digital tools and internet communication.	Group activities, discussions, active learning Tutorial (1 hr), practical exercises (1 hr), interactive lecture (1 hr)

		Learning outcomes: O2, O3, O5
Students' individual differences (16%)	Meeting students' individual differences for supporting effective teaching and learning. Learning styles. Motivation.	Interaction of teacher and participants, Active learning, group activities, self-analysis Interactive lecture (1 hr), Practical exercises (1 hr), self-study (2 hr) Learning outcomes. O3, O5
Teaching and learning methodology (20%)	Activation of students. Supporting active learning and collaborative work. Methodology - effective teaching models, methods and strategies. Managing and developing effective process of teaching and learning in Learning Management System. Lesson models. CDIO.	Group activities, discussions, active learning Interactive lecture (1 hr), Tutorial (1 hr), practical exercises (1 hr), self-study (2 hr) Learning outcomes: O3, O4, O5, O6
Assessment and feedback (16%)	Managing and developing effective process of teaching and learning. Assessment and feedback methods	Interactive lecture (1 hr), tutorial (1 hr), practical exercises (1 hr), self-study (1 hr) Active learning Learning outcomes. O6, O7
Reflection (12%)	Reflection and analysis of the process of teaching and learning. Reflection models (Korthagen, Gibbs, onion model, couching and mentoring models etc/)	Practical exercises (2 hr), tutorial (1 hr) Active learning Learning outcomes: O1, O2, O3, O4, O5, O6, O7, O8
Final Presentations (8%)	Presentation of a course portfolio and course analysis	Presentations Self-study (2 hr) Learning outcomes: O1, O2, O3, O4, O5, O6, O7, O8

IV – ASSESSMENT PROCEDURE
Self-Assessment Self-analysis of one's course design using didactical models, analysis of the designed learning outcomes and the process of learning and teaching, reflections on teaching – all analyzed and presented in a course portfolio. Pencil & paper, *Catme* freeware, E-portfolio environment (padlet, Google, Brightspace, FolioSpaces etc)
Peer-Assessment (formative), feedback in tutorials and practical exercises, in group work and presentations. Feedback
Teacher´s Assessment

Pass/fail assessment at the end of the course (summative) on the basis of the whole learning process. Formative assessment (feedback) during active learning, group work and team-based learning. Using of learning analytics. Self-assessment (portfolio) 60%, peer-assessment and participation in group works (30%), Final presentation (10%).

ASSESSMENT TOOLS (ONE TABLE FOR EACH TOOL)

ASSESSMENT TOOL 1

NAME	Self-assessment
TOOL TYPE	Analysis, reflection and metacognition. Reflection models (Korthagen, Gibbs, onion model, mentoring model, etc) Self-assessment questionnaire
ASSESSMENT TYPE	Formative
IMPLEMENTATION	Pencil & paper, *Catme* freeware, reflection model, course portfolio (E-portfolio environment), online questionnaire
DESCRIPTION	Self-analysis of one's course design, analysis of the designed learning outcomes and the process of learning and teaching, reflections on teaching presented in the course portfolio.
CRITERIA, RUBRICS, RATING SCALES	For self-improvement

ASSESSMENT TOOL 2

NAME	Peer-assessment
TOOL TYPE	Feedback models (constructive, coaching, etc)
ASSESSMENT TYPE	Formative
IMPLEMENTATION	Pencil & paper, Catme freeware
DESCRIPTION	Feedback at tutorials and practical exercises, in group work and presentations.
CRITERIA, RUBRICS, RATING SCALES	For improvement of the course design expertise

ASSESSMENT TOOL 3

NAME	Feedback
TOOL TYPE	Teacher's assessment
ASSESSMENT TYPE	Formative
IMPLEMENTATION	Paper & pencil, Catme freeware, interview
DESCRIPTION	Formative assessment (feedback) during active learning, group work and team-based learning.
CRITERIA, RUBRICS, RATING SCALES	For improvement of the course design expertise

ASSESSMENT TOOL 4

NAME	Pass/fail assessment (final assessment)
TOOL TYPE	Teacher's assessment

ASSESSMENT TYPE	Summative
IMPLEMENTATION	Paper & pencil, Catme freeware, portfolio analysis, feedback
DESCRIPTION	Pass/fail assessment at the end of the course (summative) on the basis of the whole learning process, designed portfolio and final presentation
CRITERIA, RUBRICS, RATING SCALES	All requirements fulfilled – participation in group-works, self-study exercises done, portfolio designed, course evaluated and analysed, final presentation made.

ASSESSMENT TOOLS VERSUS OUTCOMES

TOOLS / OUTCOMES	TOOL 1 SELF-ASSESSMENT	TOOL 2 PEER-ASSESSMENT	TOOL 3 TEACHER'S FEEDBACK	TOOL 4 TEACHER'S PASS/FAIL ASSESSMENT
O1	X	X	X	X
O2	X	X	X	X
O3	X	X	X	X
O4	X	X	X	X
O5	X	X	X	X
O6	X	X	X	X
O7	X	X	X	X
O8	X		X	X

ASSESSMENT: ACHIEVED LEVEL OF LEARNING OUTCOMES (TO BE FILLED DURING OR AT THE END OF THE COURSE)

OUTCOME	NOT IMPLEMENTED	ATTEMPTED IMPLEMENTATION	MANY DEFECTS	SOME DEFECTS	MINOR DEFECTS	CORRECT	EXCEPTIONAL
OUTCOME 1							
OUTCOME 2							
…							
OUTCOME N							

Levels of outcomes' achievement correspond to:

- **Exceptional** - exceeded all goals; applied knowledge to new situations and / or solved standard problems competently
- **Correct** - achieved all objectives in a minimally competent manner; applied the knowledge and skills to known standard cases
- **Minor defects** - achieved the most important goals competently; denoted some shortcomings
- **Some defects** - reached the objectives in general computation; demonstrated some weaknesses/defects
- **Many defects** - achieved only minimum goals; demonstrated many weaknesses/defects
- **Attempted Implementation** - failed to meet minimum objectives; demonstrated some skills
- **Not Implemented** - have not demonstrated a minimally significant set of skills; violated fundamental principles of engineering science / pedagogy and / or nothing minimally acceptable was produced

NOTES (PRIVATE/RESTRICTED TO THIS FORM)

NOTES (PUBLIC/TO BE AVAILABLE ONLINE)

SYLLABUS FOR COURSE 3.5. ENGINEERING INNOVATION PROCESS

INSTITUTION:	**TO BE FILLED LATER**
PROGRAM:	**IPET 3**
COURSE:	**3.5. ENGINEERING INNOVATION PROCESS**

I – IDENTIFICATION						
COMPULSORY COURSE	**CONTACT TIME - HOURS**				**SELF-STUDY - HOURS**	**CREDITS ECTS**
	LECTURES	**TUTORIALS**	**PRACTICAL /PROJECT**	**TOTAL**		
ENGINEERING INNOVATION PROCESS	**10**	**5**	**20**	**35**	**15**	**2**

FORMAL PREREQUISITES (IF ANY): THE FOLLOWING MODULES OF THE IPET 1.2; 1.3; 2.4
COURSE WEBSITE URL: TO BE FILLED LATER

II – AIMS, SYNOPSIS, CHARACTERIZATION

Aims – overview (max. 750 characters)

Classes are oriented to contribute to the development of educators reasoning and abstraction capabilities, to provide them the basic concepts and methods of Engineering Innovation allowing educators to develop new products. Educators must endow to the language, the knowledge of Engineering Innovation, entrepreneurship, and value analysis; Promote the development of reasoning and critical thinking; Develop the faculty of abstraction, of structure problems and producing problem solving strategies; Apply the previous skills to specific problems in their area of Engineering; Learn and apply mathematical concepts in order to be able to solve complex problems; Succeed on multidisciplinary teams and communicate effectively.

Specific Aims (max. 1000 characters)

At the end of the course, it is expected the educators are able to:

1. Analyse a document and extract the fundamental ideas and problems. (O1)
2. Identify and define the problem by identifying the opportunity. (O2)
3. Analyse Customer's needs. (O3)
4. Analyse and experiment the MVP (Most Viable Product). (O4)
5. Develop the solutions, measure outcomes, reflect on what worked and determine their impact in the market. (O5)
6. Refine the solution. (O6)
7. Identify, evaluate and generate innovative concepts to real-world engineering problems in a business and innovation environment. (O7)
8. Understand decision-making responsibilities at the interface between business and innovation to improve project outcomes. (O8)
9. Apply technical knowledge to entrepreneurial and start-up company opportunities to a competitive funding environment. (O9)

Contents (max. 1000 characters)

Unit 1 Introduction to Innovation (2 hours – 20%)

For clear understanding what are the innovation and the innovation process, engineers' vital role in their creation, development and realization the trainees should start with Unit 1 "Introduction to Innovation".

1.1 Innovation Types
1.2 Innovation Methods& Methodologies
1.3 Engineers as Innovators

Unit 2 Engineering Thinking (2 hours – 20%)

An innovation process is normally an experimental moment with chaotic thoughts and with "Eureka" moments. In the beginning, there is a lot of information exchange in different domains, so educators must be critical thinkers and Unit 2 will help them in making choices through engineering reasoning. Process innovation is unpredictable and uncertain, where it emerges several solutions that must be analysed according to relevant frameworks

2.1 Engineering Reasoning
2.2 Design Analysis
2.3 Document Analysis

Unit 3 Innovation Engineering (3 hours – 30%)

Unit 3 will give them tools to identify and analyse the opportunity [1] based on research, design engineering, manufacturing and plan to market. "It may start with the identification of a market need first, followed by technology and product development" [2]. Transferring information from one stage to another, working in group in product development, sometimes "worker time is wasted, and total processing time tends to be longer". In this context the agile methodologies will help them preparing and planning their work.

3.1Analysis and Identification of the opportunity (Front-end Engineering + MVP)
3.2 Agile Methodologies
3.3 Business Model (CANVAS + LEAN CANVAS)

Unit 4 Customer Analysis + Market analysis (3 hours – 30%)

Since this process start with the identification of a market need, is at huge importance to make a customer value analysis, identifying in Unit 4 requirements analysis and benefits versus cost.

4.1 Requirements Analysis
4.2 Quality Function deployment
4.3 Benefits Versus Costs

[1] Koen, P. A., Ajamian, G. M., Boyce, S., Clamen, A., Fisher, E., Fountoulakis, S., ... & Seibert, R. (2002). Fuzzy front end: effective methods, tools, and techniques. *The PDMA toolbook 1 for new product development*.
[2] Parthasarthy, R., & Hammond, J. (2002). Product innovation input and outcome: moderating effects of the innovation process. *Journal of engineering and technology management*, *19*(1), 75-91.

Main Teaching Material

1. Sire, P., Prevost, E., Guillou, Y., Riwan, A., & Saulais, P. (2019, October). How Can TRIZ Tools Tremendously Stimulate the Lean Canvas Analysis to Foster Start-Up Business Model and Value Proposition?. In International TRIZ Future Conference (pp. 93-105). Springer, Cham.
2. Saulais, P. (2019, October). How Can TRIZ Tools Tremendously Stimulate the Lean Canvas Analysis to Foster Start-Up Business Model and Value Proposition?. In New Opportunities for Innovation Breakthroughs for Developing Countries and Emerging Economies: 19th International TRIZ Future Conference, TFC 2019, Marrakesh, Morocco, October 9–11, 2019, Proceedings (Vol. 572, p. 93). Springer Nature
3. Popa I. L., Preda G., Boldea M. (2010) A Theoretical Approach of the Concept of Innovation. Managerial Challenges of the Contemporary Society, 1, 151-156

4. Osterwalder, A., Pigneur, Y., Oliveira, M. A. Y., & Ferreira, J. J. P. (2011). Business Model Generation: A handbook for visionaries, game changers and challengers. African journal of business management, 5(7), 22-30.
5. Villegas, G. U. (2011). Rethinking Engineering Education: The CDIO Approach. Sistemas & Telematica, 9(16), 91-93.
6. Al Atabi, Mushtak. Think Like an Engineer: Use systematic thinking to solve everyday challenges & unlock the inherent values in them. CreateSpace Independent Publishing Platform, 2014.
7. Crawley, Edward, Johan Malmqvist, Soren Ostlund, Doris Brodeur, and Kristina Edstrom. "Rethinking engineering education." The CDIO Approach 302 (2007): 60-62.
8. Nichols, M., Cator, K., and Torres, M. (2016) Challenge Based Learner User Guide. Redwood City, CA: Digital Promise

Complementary Teaching Material

1. Matsunaga, N. (2019). Introduction to innovation. In Innovation in developing countries (pp. 1-22). Springer, Singapore.
2. Koen, P. A., Ajamian, G. M., Boyce, S., Clamen, A., Fisher, E., Fountoulakis, S., ... & Seibert, R. (2002). Fuzzy front end: effective methods, tools, and techniques. The PDMA toolbook 1 for new product development.
3. Parthasarthy, R., & Hammond, J. (2002). Product innovation input and outcome: moderating effects of the innovation process. Journal of engineering and technology management, 19(1), 75-91.
4. Caird, Sally, Stephen Hallett, and Stephen Potter. "The Open2-Innova8ion Tool—A software tool for rating organisational innovation performance." Technovation 33, no. 10-11 (2013): 381-385.
5. Boyd, Drew and Goldenberg, Jacob (2013). Inside the Box: A Proven System of Creativity for Breakthrough Results. ISBN-978-1-4516-5925-2. Simon & Schuster Paperbacks (2013).

Teaching/Learning Tools

- Software tools (Teams; Trello; or others).
- Scrum Boards.
- White Boards.
- Zoom platform
- Lab Remote: LabsLand

Previous knowledge assumed as acquired

Material	Source
-	-

Teaching/Learning methodology

The teaching method presumes a strong interaction between educators and teachers, the educators must participate in active and regular way in each one of them - active learning pattern.

Interactive lecturing is used for delivering and discussing theoretical issues of discipline.

In the practical classes the main goal is to ensure that educators understood the topics presented in the classes. These classes are based on EduScrum methodology - active learning pattern (Active Student, Challenge understanding, Groups work).

Characterization of objectives and course program
A – Estimated percentage distribution of pedagogical and technological content

- Pedagogical component – 30 %
- Technological component (applies to design and process operation) – 70 %

Characterization of objectives and course program
B – Outcomes – in conformity with EUR-ACE criteria (later on we will adjust this to the ENTER Standards)

Group of outcomes	**Outcome**
Knowledge and Understanding	O1; O2; O3; O4; O5; O6; O8; O9.
Organization of students' Engineering Analysis	O5; O7.
Organization of students' Engineering Design	O4, O6, O8, O9.
Organization of students' Investigations	O1, O2, O5, O7.
Organization of students' Engineering Practice	O4; O6; O7; O8; O9
Transferable Skills	O1; O2; O7; O9.

III – PLANNING

COMPULSORY UNITS of the Course (including self-guided learning)	**SUMMARY**	**OBSERVATIONS**
Unit1- Introduction to Innovation	This unit acquaints trainees with types of innovations and innovation processes, basic methods and methodologies of engineering innovation.	Number of contact hours:2hours Self-study/autonomous:2hours Outcomes: O1; O7
Unit 2 - Engineering Thinking	In this unit the student must find the engineering purpose, and sources of information where the experiments/innovative idea should be applicable. TRIZ and ARIZ Scientific Methods for problem solving	Number of contact hours: 2hours Self-study/autonomous:2hours Outcomes: O1; O2; O8
Unit 3- Innovation Engineering	In this unit student must be able to identify a problem or a need to find a solution to solve it. He must identify the market opportunities/mission and purpose/design a new product/ service.	Number of contact hours: 3hours Self-study/autonomous:6hours

III – PLANNING		
COMPULSORY UNITS of the Course (including self-guided learning)	**SUMMARY**	**OBSERVATIONS**
Unit1- Introduction to Innovation	This unit acquaints trainees with types of innovations and innovation processes, basic methods and methodologies of engineering innovation.	Number of contact hours:2hours Self-study/autonomous:2hours Outcomes: O1; O7
Unit 2 - Engineering Thinking	In this unit the student must find the engineering purpose, and sources of information where the experiments/innovative idea should be applicable. TRIZ and ARIZ Scientific Methods for problem solving	Number of contact hours: 2hours Self-study/autonomous:2hours Outcomes: O1; O2; O8
		Outcomes: O4; O5; O7; O8
Unit 4 - Customer Analysis + Market analysis	The student must be able to make a complete market analysis based on methods and graphics.	Number of contact hours: 3hours Self-study/autonomous:5hours Outcomes: O3; O5; O6; O9

IV – ASSESSMENT PROCEDURE
Self-Assessment: -
Teacher´s Assessment: The tools 1,2 and 3 will be needed to the teacher´s assessment and will be divided according to the following items: Groups presentation (60%), report (30%), peer evaluation (10%). More detailed: Pedagogical component: Peer evaluation -10% Technological component: Presentation (Pitch Format – 40%) + Market Analysis (TAM/SAM/SOM; Competitors; Business Model-20%) + Report (30%) – 90 %

ASSESSMENT TOOLS (ONE TABLE FOR EACH TOOL)

ASSESSMENT TOOL 1

NAME	Presentation + Market Analysis+ Report
TOOL TYPE	Idea development for groups (4 to 6 educators) (Tool 1) - **EduScrum Teamwork**

ASSESSMENT TYPE	Summative
IMPLEMENTATION	Practical classes
DESCRIPTION	Idea development in groups, based on opportunities/needs, market analysis and customer needs.
CRITERIA, RUBRICS, RATING SCALES	

			Very Good	Good	Satisfatory	Needs Improvement
			4 - excellent	3- good	2- fair	1- poor
Groups Presentation 60%	40%	**Communication & time Management**				
		Business Model				
		Presentation Quality				
	20%	**DEMO**				
	30%	**REPORTS**				
	10%	**Peers Evaluation**				

ASSESSMENT TOOL 2

NAME	Mini Presentation and feedback of the teamwork + DEMO
TOOL TYPE	Idea development for groups (4 to 6 educators) - **Sprints** (Tool2)
ASSESSMENT TYPE	Formative (performance of the student during the course)
IMPLEMENTATION	Practical classes
DESCRIPTION	Idea development in groups, based on opportunities/needs, market analysis and customer needs.
CRITERIA, RUBRICS, RATING SCALES	Technological component: Presentation (Mini presentation) + DEMO

ASSESSMENT TOOLS VERSUS OUTCOMES

TOOLS / OUTCOMES	TOOL 1	TOOL 2
OUTCOME 1		x
OUTCOME 2	x	x
OUTCOME 3	x	x
OUTCOME 4		x
OUTCOME 5	x	
OUTCOME 6	x	x
OUTCOME 7	x	x
OUTCOME 8	x	x
OUTCOME 9	x	x

ASSESSMENT: ACHIEVED LEVEL OF LEARNING OUTCOMES (TO BE FILLED DURING OR AT THE END OF THE COURSE)

OUTCOME	NOT IMPLEMENTED	ATTEMPTED IMPLEMENTATION	MANY DEFECTS	SOME DEFECTS	MINOR DEFECTS	CORRECT	EXCEPTIONAL
OUTCOME 1							
OUTCOME 2							
...							
OUTCOME N							

Levels of outcomes' achievement correspond to:

- **Exceptional** - exceeded all goals; applied knowledge to new situations and / or solved standard problems competently
- **Correct** - achieved all objectives in a minimally competent manner; applied the knowledge and skills to known standard cases

- **Minor defects** - achieved the most important goals competently; denoted some shortcomings
- **Some defects** - reached the objectives in general computation; demonstrated some weaknesses/defects
- **Many defects** - achieved only minimum goals; demonstrated many weaknesses/defects
- **Attempted Implementation** - failed to meet minimum objectives; demonstrated some skills
- **Not Implemented** - have not demonstrated a minimally significant set of skills; violated fundamental principles of engineering science / pedagogy and / or nothing minimally acceptable was produced

NOTES (PRIVATE/RESTRICTED TO THIS FORM)

None

NOTES (PUBLIC/TO BE AVAILABLE ONLINE)

None

SYLLABUS FOR COURSE 3.6. FINAL PROJECT

INSTITUTION:	**TO BE FILLED LATER**
PROGRAM:	**iPET 3**
COURSE:	**3.6. FINAL PROJECT**

I – IDENTIFICATION						
COMPULSORY COURSE	**CONTACT TIME – HOURS**				**SELF-STUDY - HOURS**	**CREDITS ECTS**
	LECTURES	**TUTORIALS**	**PRACTICAL /PROJECT**	**TOTAL**		
FINAL PROJECT	**0**	**25**	**25**	**50**	**25**	**3**

FORMAL PREREQUISITES (IF ANY): iPET1, iPET2
COURSE WEBSITE URL: TO BE FILLED LATER

II – AIMS, SYNOPSIS, CHARACTERIZATION
Background (max. 600 characters) The final project allows educators to conclude, share and present their teaching credentials and experiences acquired during the Engineering Educators' pedagogical training program iPET, thus proving their compliance to the qualification of an engineering educator and displaying their competencies and qualifications to administrations and potential employers in a professional manner. The final project gives a professional view of teaching as a scholarly activity.
Aims – overview (max. 750 characters) To integrate and demonstrate the competencies acquired from iPET-1, iPET-2 and iPET-3 in a final project, engineering educators design a teaching portfolio and a teaching philosophy statement. Teaching portfolio presents the syllabi, assignments, and other materials that best illustrate educators' teaching approach and methods. A portfolio offers evidence of teaching effectiveness, reflection and self-analysis for further development. Engineering Educators present a research project and interactive sample interactive lesson that is analysed in the portfolio. The final project may be based any iPET course.
Specific Aims (max. 1000 characters) After passing Engineering Educators Pedagogical Training program, educators will be able: • O1. To manage and design the effective process of teaching and learning, taking account of the main principles acquired in iPET courses; • O2. Compile a teaching portfolio and reflect on effective teaching and learning of engineering with the aim of further improvement; • O3. Compile and update their teaching philosophy statement; • O4. Design and present a final project; • O5. Present a sample interactive lesson implementing acquired competencies.
Contents (max. 1000 characters)

- Models for reflection and self-analysis (Korthagen, Gibbs, onion model, mentoring model etc). Metacognition of the process of teaching.
- Portfolio design and assessment. Peer-evaluation.
- Analysis of effective course design and interactive teaching and learning.
- Analysis of students' feedback. Giving feedback.
- Compilation of Teaching Philosophy Statement.
- Video analysis of teaching. Self-visualization and self-scoping.
- Analysis of acquired competencies at iPET courses;
- Final project. Presentation of an interactive sample lesson. Lesson analysis;
- Mentoring and coaching.
- Planning further developments and improvements.

Main Teaching Material

1. Wankat P.C., Oreovicz F.S. (2015). Teaching Engineering. Purdue University Press; 2 edition
2. Edstrom K., Crawley E.F., Ostlund S., Malmqvist J. (2016). Rethinking Engineering Education: The CDIO Approach. 2nd ed. Springer International Publishing AG
3. Felder Richard M., Brent Rebecca (2016). Teaching and Learning STEM – A Practical Guide. Jossey-Bass, A Wiley Brand.
4. Biggs J. B., Tang C. (2011). Teaching for Quality Learning at University: What the Student Does, 4th edition, Open University Press
5. Kauchak D., Eggen P. (2018). Introduction to Teaching: Becoming a Professional 6th edition, Pearson
6. Fashant Z., Ross S., Russell L., LaPlant K.P., Jacobson J., Hutchinson S., Fink L.D. (2019), Designing Effective Teaching and Significant Learning, Stylus Publishing
7. Burden P. R., Byrd D. M. (2018). Methods for Effective Teaching: Meeting the Needs of All Students 8th edition. Pearson.

Complementary Teaching Material

1. Handbook for Creating Course Portfolios https://web.uri.edu/teach/files/Course-Portfolios.pdf
2. https://www.uky.edu/celt/50-classroom-assessment-techniques-cats
3. Kalman C.S. (2018). Successful Science and Engineering Teaching: Theoretical and Learning Perspectives 2nd ed, Springer International Publishing AG
4. https://teachingcommons.stanford.edu/resources/course-preparation-resources/course-preparation-handbook/course-design

Teaching/Learning Tools

E-portfolio environments (padlet, Google, Brightspace, FolioSpaces etc.), models for self-analysis and reflection (Korthagen, Gibbs, onion model, mentoring model, etc.)

Previous knowledge assumed as acquired

Material	Source
-	-

Teaching/Learning methodology

Self-analysis, metacognition, peer-evaluation, reflections, course analysis, analysis of students' feedback, portfolio design, video analysis.

Characterization of objectives and course program
A – Estimated percentage distribution of pedagogical and technological content

- Pedagogical component – 75%
- Technological component – 25%

Characterization of objectives and course program
B – Outcomes – in conformity with EUR-ACE criteria (later on we will adjust this to the ENTER Standards)

Group of outcomes	Outcome
Knowledge and Understanding	O1
Organization of students' Engineering Analysis	O2, O3, O4
Organization of students' Engineering Design	O1, O4
Organization of students' Investigations	
Organization of students' Engineering Practice	O4, O5
Transferable Skills	O1, O2, O3, O4,O5

III – PLANNING

COMPULSORY UNITS of the Course (including self-guided learning)	SUMMARY	OBSERVATIONS
Reflection (10%)	Models for reflection and self-analysis. Metacognition of the process of teaching. Video analysis. Mentoring. Giving constructive feedback	Active learning Tutorial (2 hr), Practical exercises (3 hr), self-study (2 hr) Learning outcome: O2 *Estimated time presented, as active learning is used, the time may be changed in all units*
Portfolio design (10%)	Portfolio design. Peer-evaluation. Compilation of Teaching Philosophy Statement. Analysis of competencies. Planning further developments and improvements.	Active learning Tutorial (3 hrs), practical exercises (2 hr), self-study (2 hr) Learning outcomes: O2, O3
Course design analysis (13%)	Analysis of the Course design and interactive teaching and learning. The basic didactical model on Engineering Pedagogy Science. Didactical models (Bloom, Feisel-Schmitz, Dee Fink, Plants, Domin, Hmelo-Silver, Harrow, Hauenstein etc.)	Practical exercises (3 hrs), project tutorials (2 hr), self-study (5 hrs) Learning outcomes: O1
Feedback (13%)	Analysis of students' feedback. Analysis of teaching and learning.	Tutorial (3 hrs), practical exercises (2 hrs), self-study (5 hrs)

		Learning outcome: O2
Project (21%)	Project. Design of a sample interactive lesson. Lesson plans (models) and analysis.	Tutorial (5 hr), practical exercises (5 hr), self-study (6 hrs) Learning outcomes. O4, O5
Peer-evaluation (13%)	Portfolio assessment	active learning Practical exercises (5 hrs), project tutorials (5 hrs) Learning outcomes: O1, O2, O3
Final presentation (20%)	Presentations. Project and/or sample lesson. Final assessment	Tutorial (5 hrs), Practical exercises (5 hrs), self-study (5 hrs) Learning outcomes: O1, O2, O3, O4, O5

IV – ASSESSMENT PROCEDURE
Self-Assessment Self-analysis of one's course design and the interactive process of teaching and learning, analysis of the students' feedback, reflections on teaching. Pencil & paper, *Catme* freeware, reflection models
Peer-Assessment (formative), feedback in the project work, in group work and presentations. Feedback. Peer-evaluation of teaching portfolios and presentation of sample lessons.
Open presentation Pass/fail assessment at the end of the final project (summative) on the basis of the whole learning process and presentation of the project and portfolio. Formative assessment (feedback) during the final project. Self-assessment (20%), Peer-assessment (20%), final project (60%).

ASSESSMENT TOOLS (ONE TABLE FOR EACH TOOL)

ASSESSMENT TOOL 1

NAME	Self-assessment
TOOL TYPE	reflection and metacognition. Reflection models (Korthagen, Gibbs, onion model, mentoring model etc.)
ASSESSMENT TYPE	Formative
IMPLEMENTATION	Pencil & paper, *Catme* freeware, reflection models
DESCRIPTION	Self-analysis of one's course design, analysis of the designed learning outcomes and the process of learning and teaching, reflections on teaching. Analysis of students' feedback.
CRITERIA, RUBRICS, RATING SCALES	for self-improvement

ASSESSMENT TOOL 2

NAME	Peer-assessment
TOOL TYPE	Feedback
ASSESSMENT TYPE	Formative
IMPLEMENTATION	Pencil & paper, Catme freeware,
DESCRIPTION	feedback at tutorials and practical exercises, in group work and presentations, in the project work. Feedback. Peer-evaluation of teaching portfolios and sample lessons
CRITERIA, RUBRICS, RATING SCALES	for self-improvement

ASSESSMENT TOOL 3

NAME	Feedback
TOOL TYPE	Teacher's assessment
ASSESSMENT TYPE	Formative
IMPLEMENTATION	Pencil & paper, Catme freeware,
DESCRIPTION	Formative assessment (feedback) during final project, group work and team-based learning.
CRITERIA, RUBRICS, RATING SCALES	For acquiring competencies and self-improvement

ASSESSMENT TOOL 4

NAME	Pass/fail assessment (final)
TOOL TYPE	Open presentation
ASSESSMENT TYPE	Summative
IMPLEMENTATION	Final project, portfolio, teaching philosophy statement, presentation of a sample lesson or a project
DESCRIPTION	Pass/fail assessment at the end of the course (summative) on the basis of the whole learning process in front of the defence board.
CRITERIA, RUBRICS, RATING SCALES	For acquiring the certificate

ASSESSMENT TOOLS VERSUS OUTCOMES

TOOLS / OUTCOMES	TOOL 1 SELF-ANALYSIS	TOOL 2 PEER-ASSESSMENT	TOOL 3 TEACHER FEEDBACK	TOOL 4 OPEN PRESENTATION
O1	X	X	X	X
O2	X	X	X	X
O3	X		X	X
O4	X	X	X	X
O5	X	X	X	X

ASSESSMENT: ACHIEVED LEVEL OF LEARNING OUTCOMES (TO BE FILLED DURING OR AT THE END OF THE COURSE)

OUTCOME	NOT IMPLEMENTED	ATTEMPTED IMPLEMENTATION	MANY DEFECTS	SOME DEFECTS	MINOR DEFECTS	CORRECT	EXCEPTIONAL
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CONCLUSION

This deliverable serves as the basis for further development of iPET-3 courses. Based on the proposed syllabuses for each course, the consortium plans to prepare a thorough content plan for each course, as well as to develop a general presentation of course materials, including mandatory content of the lectures, structure, methodology and basic tasks for practical, project and self-study work. The proposed syllabuses will be applied within the trial iPET program training of engineering educators and will be revised, if needed, before the final launch of iPET programs.