Course guide
300270 - CREA - Creativity and Engineering

Last modified: 11/05/2026

Unit in charge: Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 410 - ICE - Institute of Education Sciences.

Degree: MASTER'S DEGREE IN APPLIED TELECOMMUNICATIONS AND ENGINEERING MANAGEMENT (MASTEAM) (Syllabus 2015). (Optional subject).
ERASMUS MUNDUS MASTER IN COMMUNICATIONS ENGINEERING AND DATA SCIENCE (CODAS 1) (Syllabus 2024). (Compulsory subject).
MASTER'S DEGREE IN ARTIFICIAL INTELLIGENCE FOR CONNECTED INDUSTRIES (AI4CI) (Syllabus 2025). (Optional subject).

Academic year: 2026 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Check https://mitra.upc.es/SIA/infoweb.unitatDocent?w_idioma=ENG&w_codi_ud_p=300270

Others: Check https://mitra.upc.es/SIA/infoweb.unitatDocent?w_idioma=ENG&w_codi_ud_p=300270

PRIOR SKILLS

Be a graduate in engineering or a similar discipline

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
06 MTM. (ENG) Modelar, diseñar, implementar y evaluar sistemas competitivos, cooperativos y dinámicos.

Generical:
04 DIR. (ENG) Dirigir y planificar, a nivel técnico y de gestión, cualquier proyecto de investigación, desarrollo o innovación, basado en las TIC y aplicado a cualquier ámbito de la economía productiva.
06 RES. (ENG) Resolver problemas y mejorar procesos en cualquier ámbito social a partir de la aplicación de las TIC, integrando conocimientos de diversos ámbitos y aplicando ingeniería de alto nivel tecnológico.

Transversal:
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Basic:
CB6. Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context.
CB7. Students will be able to apply the acquired knowledge and their ability to solve problems in new or little explored environments in broader (or multidisciplinary) contexts related to their study area.
CB8. Students will be able to integrate knowledge and face the complexity of formulating judgments based on information that, while being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and opinions.
CB9. Students will be able to communicate their conclusions and the knowledge and ultimate reasons that support them to specialized and non-specialized audiences in a clear and unambiguous manner.

TEACHING METHODOLOGY

Lecture assisted by slides. 40% of class time is devoted to performing exercises.
The slides will be distributed to all attendees.
Also, readings and statements of appropriate exercises will be distributed.
Analysis and discussion of current issues, with application of methods and tools for an organized approach to problem solving.
Viewing and discussion of videos from many disciplines and a wide range of sources.

LEARNING OBJECTIVES OF THE SUBJECT

The objective of this course is to help students understand and practice the techniques and tools that allow them to improve and develop their creativity, self-awareness and critical thinking skills,addressed to better decision-making in engineering. In this course, students will learn problem-solving techniques in engineering and the knowledge and use of creative techniques for obtaining new or alternative solutions, motivation, performance improvement of alternative solutions, as well as the concept of innovation in all areas of your future professional work. Following a methodology based on logic, the scientific method, lateral thinking and other creative techniques, the student will focus on obtaining solutions, taking into account both the system or service, and the environment in which the system or service will fulfill its function. The student will learn to consider the influence of their own knowledge and perception in the search for information and in the achievement of solutions. When students have successfully completed this course, they can solve problems, optimize and design products and services, dissect arguments, distinguish between good reasoning and fallacies, as well as find and point out the key elements of a discussion. Critical thinking will also be encouraged, which will allow them to articulate and defend their own points of view, and recognize and identify possible flaws in their beliefs and reasoning. Theoretical examples and case-study discussion followed by some specific exercises, will introduce the students in self-management, innovation and leadership competences.

It is also a goal of this course to motivate and increase the enthusiasm of engineering students.

STUDY LOAD

Type	Hours	Percentage
Hours large group	27,0	36.00
Self study	48,0	64.00

Total learning time: 75 h

CONTENTS

1. Introduction. Some critical concepts. Taxonomies.

Description:
1. Introduction. Some critical concepts. Taxonomies.
• Ideas
• Creativity
• Engineering problem solving
• Effectiveness vs. Efficiency
• Identity Environment-System
• Innovation
• Types of Innovations
• The "killer applications"
• Keys for a innovative entrepreneurship
• Innovation cases
• Reflexions about Innovation
• Inventions
• Examples and Creativity cases
• Creativity performance
• Features of geniuses

Specific objectives:
To introduce to the students the concepts of creativity and innovation, the role played by the environment in the definition, understanding and resolution of problems. The classification and differences between creativity, innovation and inventions. Presentation of the determining characteristics of creators, innovators and entrepreneurs

Related activities:
by temary and by several group exercises done in class and homework exercises (individual)
- Discussion and exercises about deep thinking.
- Improvement of designs by adding, changing or removing something
- Design of a new product, service or application.
- Discussion about a currently technological item.

Related competencies :
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
CB6. Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context.
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Full-or-part-time: 19h 30m
Theory classes: 7h
Self study : 12h 30m

2. Critical Thinking

Description:
2. Critical Thinking
• Data, information and knowledge
• Critical Thinking
• Famous engineers performances
• Development of knowledge
• Research and obtain information
• Perception
• Thinking and reasoning
• Conscious and subconscious Mind.
• Role of the Mind in Learning
• The Heuristics
• Reasoning
• Brain and Mind

Specific objectives:
To present the basis of critical thinking, how we acquire knowledge through information and our senses, how the mind works. What are the heuristic barriers, how to control the subconscious in creative processes

Related activities:
by temary and by several group exercises done in class and homework exercises (individual).
- Discussion and exercises about deep thinking.
- Discussion about a currently technological item.
- Several short exercises proposed and solved in class sessions.

Related competencies :
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
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CB8. Students will be able to integrate knowledge and face the complexity of formulating judgments based on information that, while being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and opinions.
CB9. Students will be able to communicate their conclusions and the knowledge and ultimate reasons that support them to specialized and non-specialized audiences in a clear and unambiguous manner.
CB7. Students will be able to apply the acquired knowledge and their ability to solve problems in new or little explored environments in broader (or multidisciplinary) contexts related to their study area.

Full-or-part-time: 14h
Theory classes: 5h
Self study : 9h

3. Problem Solving and Engineering Design

Description:
3. Problem Solving and Engineering Design
• Finding creative solutions
• Strategy to promote creativity.
• Convergent and Divergent Problems
• Procedures for obtaining solutions.
• Team Leadership
• Leadership and Executive Intelligence.

Specific objectives:
General presentation of engineering methods applied to the solution of problems and design. Classification of problems and designs. Leadership and teamworks.

Related activities:
by temary and by several group exercises done in class and homework exercises.
- Improvement of designs by adding, changing or removing something
- Design of a new product, service or application.
- Discussion about a currently technological item.
- Design of a new engineering product or service

Related competencies :
06 RES. (ENG) Resolver problemas y mejorar procesos en cualquier ámbito social a partir de la aplicación de las TIC, integrando conocimientos de diversos ámbitos y aplicando ingeniería de alto nivel tecnológico.
04 DIR. (ENG) Dirigir y planificar, a nivel técnico y de gestión, cualquier proyecto de investigación, desarrollo o innovación, basado en las TIC y aplicado a cualquier ámbito de la economía productiva.
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Full-or-part-time: 14h
Theory classes: 5h
Self study : 9h

4. Creative Techniques and procedures.s

Description:
4. Creative Techniques
• Pure Creative techniques.
- Logical Thinking
- Lateral Thinking
- Reversal Method
- Synectics, Make Connections (Forced Relationships)
- Analogies
- Partition, Division, or Discretization
- Visual Thinking
- Key Questions (SCAMPER)
- Other minor techniques

• Creative Systematized Procedures

- Tree of Ideas or Mind Maps
- SWOT (Strengths, Weaknesses, Opportunities, and Threats)
- "Six Hats" Method
- Morphological Matrix Method.
- Brainstorming
- Design Thinking
- Creative Problems Solver (CPS)
- TRIZ method
- Delphi Method

Specific objectives:
Introduction and description of the main creative techniques and procedures for solving problems and designing products and services. The techniques are grouped into purely creative techniques, and systematized procedures. All the techniques are accompanied by practical exercises both individually and in teams.

Related activities:
by temary and by several group exercises done in class and homework exercises.
- Improvement of designs by adding, changing or removing something
- Design of a new product, service or application.
- Discussion about a currently technological item.
- Design of a new engineering product or service
- Several short exercises proposed and solved in class sessions.

Related competencies :
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Full-or-part-time: 22h
Theory classes: 8h
Self study : 14h

5. Summary and Conclusions

Description:
5. Summary and Conclusions
• Summary of all main subject concepts.
• Critical review of the subject and teacher.
• Proposed improvements.

Specific objectives:
Critical review of the subject, the teacher and the students. Review and specification of the main concepts. Proposals for improvement and refinements.

Related activities:
Competences: CB8-CB9-CB10-E06-T05-T06 by the temary and by several group exercises.

Related competencies :
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Full-or-part-time: 5h 30m
Theory classes: 2h
Self study : 3h 30m

ACTIVITIES

- Discussion and exercises about creativity, critical thinking and decision-making

Description:
- Exhaustive discussion on seemingly simple topics. Example: 20 ways to cross a river, 20 ways to know the height of a building, 20 ways to empty a glass of water, etc

Specific objectives:
That students are aware when they think, introduction to critical thinking

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CB6. Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context.

Full-or-part-time: 1h 30m
Theory classes: 1h 30m

- Design of a new product, service or application.

Description:
Design of a new products or services: container for toothpaste, new lenses, new apps for smartphone, etc. Teamwork.

Specific objectives:
Initiation to design, specification, conceptualization, information, search for alternatives, decision, realization and refinement.

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Full-or-part-time: 1h 30m
Theory classes: 1h 30m

- Discussion about a currently technological item.

Description:
Use of analysis techniques for the decision on alternatives, especially through the "6 hat technique", for example, discussion on a new transgenic fruit, or a new nanomechanical shaving machine etc.. Teamwork.

Specific objectives:
Practice with decision-making techniques

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Full-or-part-time: 1h
Theory classes: 1h

- Design of a new engineering product or service

Description:
Design of a new element (Ex: bag for ICT engineers, or a new suitcase trolley, or a new voice information service, or a new friend social network, etc.). Teamwork. Oral presentation.

Specific objectives:
Initiate students in the design of new applications and services, especially those related to ICT

Related competencies :
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Full-or-part-time: 1h 30m
Theory classes: 1h 30m

- Several short exercises proposed and solved in class sessions.

Description:
Questions and quizs about logic, lateral thinking and creativity.

Specific objectives:
Reach competences using creativity techniques and student personal evaluation.

Related competencies :
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Full-or-part-time: 3h
Theory classes: 3h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

Ongoing evaluation of weekly assignments exercises, three exercisses per week, and class contributions to the discussions proposed.

Check https://mitra.upc.es/SIA/infoweb.unitatDocent?w_idioma=ENG&w_codi_ud_p=300270

EXAMINATION RULES.

The evaluation is continuous through the weekly exercises, its solution is discussed and discussed in class. The final grade is the average of the evaluation of the exercises nuanced by the individual interventions and the team exercises solved in class. Final oral presentation of a MiniProject.

BIBLIOGRAPHY

Basic:
- De Bono, Edward. Lateral thinking : creativity step by step. New York: Harper Perennial, 1990. ISBN 9780060903251.
- Boden, Margaret A. The creative mind : myths and mechanisms [on line]. Second edition. London ; New Yotk: Routledge, 2004 [Consultation: 12/02/2026]. Available on: https://www-taylorfrancis-com.recursos.biblioteca.upc.edu/books/mono/10.4324/9780203508527/creative-mind-margaret-boden. ISBN 9780203508527.
- Haber, Jonathan. Critical thinking [on line]. Cambridge: The MIT Press, [2020] [Consultation: 30/09/2026]. Available on: https://research-ebsco-com.recursos.biblioteca.upc.edu/c/ik5pvi/search/details/xie32srezv?request-context=plink&db=nlebk. ISBN 9780262357357.
- Boden, Margaret A. Dimensions of creativity [on line]. First MIT Press papterback edition. 1994 [Consultation: 30/09/2026]. Available on: https://research-ebsco-com.recursos.biblioteca.upc.edu/c/ik5pvi/search/details/kenrrdq6mz?request-context=plink&db=nlebk. ISBN 9780262268868.

Complementary:
- Petroski, Henry. La Ingeniería es humana : la importancia del fallo en el éxito del diseño. Madrid: Cinter, 2007. ISBN 9788493227029.
- Marina, José Antonio. Teoría de la inteligencia creadora. 1a ed. en esta colección. Barcelona: Anagrama, 2000. ISBN 8433966529.
- Paul, Richard; Elder, Linda. Critical thinking : tools for taking charge of your professional and personal life [on line]. Second edition. Lanham, Maryland: Rowman & Littlefield, 2013 [Consultation: 18/02/2026]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=6374242. ISBN 9781538139530.
- Michalko, Michael. Thinkertoys : cómo desarrollar la creatividad en la empresa. Barcelona: Gestión 2000, 1999. ISBN 8480885998.
- Chaffee, John. Thinking critically. 10th ed., international ed. Boston: Wadsworth Cengage Learning, cop. 2012. ISBN 9780495914037.
- De Bono, Edward. Seis sombreros para pensar. Barcelona: Granica, DL 1996. ISBN 8475774415.
- Brand, Stewart. El Laboratorio de medios : inventando el futuro en el M.I.T.. Madrid: FUNDESCO, cop. 1989. ISBN 8486094542.

RESOURCES

Audiovisual material:
- Projections. PC and screen projector

Hyperlink:
- Apple Research (2025): The Illusion of Thinking. https://machinelearning.apple.com/research/illusion-of-thinking- The Dance of The Possible (Scott Berkun). https://scottberkun.com/wp-content/uploads/2017/10/Dance-Of-the-Possible-MEGA-FUN-excerpt.pdf