

Course guide

230637 - CTC - Critical Thinking and Creativity

Last modified: 04/09/2025

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree: MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2022). (Optional subject).

Academic year: 2025 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: FRANCISCO TORRES TORRES

Others:

PRIOR SKILLS

English: upper intermediate, advanced, or proficiency (equivalent to B2, C1, C2 of the Council of Europe's Common European Framework of Reference for Languages)

TEACHING METHODOLOGY

Lecture assisted by "power point" 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 aim of this course is to help students understand and practice the techniques and tools that enable them to enhance and develop their creativity as well as the appreciation of creativity in other people. In this course, students will learn the techniques of problem solving in engineering and the knowledge and use of creative techniques for obtaining new or alternative solutions, to teamwork, to motivation, for improving performance of alternative solutions, as well as the concept of innovation in all areas of their future professional work. Following a methodology based on logic, scientific method, and statistical decision theory, the student will focus problems, to appreciate the importance of the environment and interaction with the systems, and the influence of their knowledge and perception in search for information. When students have successfully completed this course will be able to troubleshoot, optimize and design products and services, dissect arguments, distinguish between good and bad reasoning, fallacies discover and find and target the key elements of a discussion. There will also be encouraged critical thinking, enabling them to articulate and defend their own views and recognize and identify possible defects in their beliefs and reasoning.

STUDY LOAD

Type	Hours	Percentage
Self study	86,0	68.80
Hours large group	39,0	31.20

Total learning time: 125 h

CONTENTS

1. Introduction. Some key concepts. Taxonomies.

Description:

- 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

Full-or-part-time: 9h

Theory classes: 9h

3. Critical Thinking

Description:

- 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, how the conscious and the subconscious act

Full-or-part-time: 15h

Theory classes: 15h

3. Problem Solving and Engineering Design

Description:

Finding creative solutions

- Strategy to promote creativity.
- Convergent and Divergent Problems
- Procedures for obtaining solutions.
- Team Leadership
- Leadership and Executive Intelligence.

Full-or-part-time: 6h

Theory classes: 6h

4. Creative Techniques

Description:

Pure Creative techniques.

- Logical thinking
- Lateral Thinking
- Reversal Techniques
- Synectics, Make Connections (Forced Relationships)
- Analogies
- Key Questions Technique (SCAMPER)
- Discretization, partition or division Techniques
- Visual Thinking
- Automated Writing Technique
- Pseudo Dream Technique

Creative Systematized Procedures

- Tree of Ideas or Mind Maps
- SWOT (Strengths, Weaknesses, Opportunities, and Threats)
- "Six Hats" Method
- Morphological Matrix Method.
- Brainstorming
- Design Thinking
- CPS (creative problem solving)
- TRIZ (Theory of Inventive Problem Solving) method
- Delphi Method

Full-or-part-time: 12h

Theory classes: 12h

5. Summary and Conclusions

Description:

- Summary of all main subject concepts.
- Critical review of the subject and teacher.
- Proposed improvements.

Full-or-part-time: 3h

Theory classes: 3h

GRADING SYSTEM

Ongoing evaluation of weekly assignments exercises and class contributions to the discussions proposed: 100%

BIBLIOGRAPHY

Basic:

- Boden, Margaret. The creative mind [on line]. 2nd ed. London & New York: Routledge, 2004 [Consultation: 06/10/2025]. Available on: <https://www-taylorfrancis-com.recursos.biblioteca.upc.edu/books/mono/10.4324/9780203508527/creative-mind-margaret-boden>. ISBN 9780203508527.
- Review, Harvard Business. HBR Guide to Critical Thinking [on line]. Boston, MA.: Harvard Business Review Press, 2023 [Consultation: 04/09/2025]. Available on: <https://store.hbr.org/product/hbr-guide-to-critical-thinking/10587>. ISBN 9781647824471.
- Chaffee, J. Thinking critically. 10th ed., int. ed. Boston: Wadsworth Cengage Learning, 2012. ISBN 9780495914037.
- Paul, R.W.; Elder, L. Critical thinking: tools for taking charge of your professional and personal life. 2nd ed. Upper Saddle River: Pearson Education, 2014. ISBN 9780133115284.
- Ruggiero, V.R. The art of thinking: a guide to critical and creative thought. 10th ed. New York: Pearson Education, 2012. ISBN 9780205108930.
- McCuen, Richard. Critical Thinking, Idea Innovation, and Creativity [on line]. Boca Raton: CRC Press, 2023 [Consultation: 06/10/2025]. Available on: <https://www-taylorfrancis-com.recursos.biblioteca.upc.edu/books/mono/10.1201/9781003380443/critical-thinking-idea-innovation-creativity-richard-mccuen>. ISBN 9781003380443.

Complementary:

- Bell, T.E.; Dooling, D. Engineering tomorrow: today's technology experts envision the next century. New York: IEEE Press, 2000. ISBN 0780353625.
- Marina, J.A. Teoría de la inteligencia creadora. Barcelona: Anagrama, 2000. ISBN 9788433966520.
- De Bono, E. El pensamiento lateral: manual de creatividad. Barcelona: Paidós, 2013. ISBN 9788449329456.
- De Bono, E. Seis sombreros para pensar. Barcelona: Granica, 1996. ISBN 8475774415.
- Michalko, M. Thinkertoys: cómo desarrollar la creatividad en la empresa. Barcelona: Gestión 2000, 1999. ISBN 8480883561.
- Brand, S. El laboratorio de Medios: inventando el futuro en el M.I.T. Madrid: Fundesco, 1989. ISBN 8486094542.
- Henry Petroski. To engineer is human: the role of failure in successful design. New York: Ed. Random House, 1992. ISBN 0679734163.

RESOURCES

Hyperlink:

- Masterclass - Scott Berkun - Managing Ideas, Creative Thinking and Communication: <https://www.youtube.com/watch?v=vUeY-xcMOKM>
- The Dance of The Possible (five open access chapters). <https://scottberkun.com/wp-content/uploads/2017/10/Dance-Of-the-Possible-MEGA-FUN-excerpt.pdf>- Apple Research (2025): The Illusion of Thinking. <https://machinelearning.apple.com/research/illusion-of-thinking>- Blockley, D. (2020): Creativity, Problem Solving, and Aesthetics in Engineering. <https://link.springer.com/book/10.1007/978-3-030-38257-5>- Hernández-Fernández, A. (ed.) (2023). Creativitat digital. Diàlegs UPCArts. UPC.. <https://hdl.handle.net/2117/395833>