Universidad de Alcalá

TEACHING GUIDE

Ethics in Engineering and Artificial Intelligence

Transversal Subject

University of Alcalá

Academic Year 2021/2022

Second Semester

Approved by the School Board on July 6, 2021

TEACHING GUIDE

Name of the course:	**Ethics in Engineering and Artificial Intelligence**
Code:	**100182**
Degrees:	**All Engineering Degrees at the Polytechnic School**
Department / Teaching area:	**Computer Engineering Department / Systems Engineering and Automation**
Type:	**Cross-disciplinary (transversal)**
ECTS credits:	**6**
Year and semester:	**2nd Semester**
Teachers:	**Noelia Hernández Parra (coordinator)**
Office hours:	**Will be provided at the first lecture.**
Language:	**Spanish / English Friendly**

1. COURSE SUMMARY

Engineers are supposed to carry out their professional work competently and skilfully. But they are also supposed to be aware of the broader ethical and social implications of engineering, and to be able to analyze them and to think about potential decisions that can be made based on the ethical dimension of the engineering problems.

According to the Standards and Guidelines of EUR-ACE Framework from ENAEE, it is expected from the bachelor degree programs to endow the students with the "*ability to gather and interpret relevant data and handle complexity within their field of study, to inform judgements that include* ***reflection on relevant social and ethical issues***" as well as with the "*ability to manage complex technical or professional activities or projects in their field of study,* ***taking responsibility for decision making***". In addition, according to the Engineering Criteria of the Accreditation Board for Engineering and Technology (ABET) in the US, engineers must have "*an* ***understanding of professional and ethical responsibility***" and should "***understand the impact of engineering solutions*** *in a global and societal context.*"

This course focuses on concrete ethical problems that engineers might encounter in their professional practice. With the help of concrete cases is shown how the decisions involved in the design, development and production of technological solutions, are inherently ethical. We aim to endow students in the engineering field (mainly, but not exclusively) with the adequate methodology and tools to identify

ethical engineering problems, to objectively analyze them (identifying all the stakeholders) and provide potential actions based on the moral dimension.

2. SKILLS & LEARNING OUTCOMES

Basic skills:

- CB3 - That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include reflection on relevant social, scientific or ethical issues.
- CB4 - That students can communicate information, ideas, problems and solutions to both specialized and non-specialized audiences.

General skills (from Telecommunication Engineering studies):

- TR3 - Ability to solve problems with initiative, decision making, creativity, and to communicate and transmit knowledge, skills and abilities, understanding the ethical and professional responsibility of the activity of the Telecommunications Technical Engineer.
- TR6 - Ability to analyze and assess the social and environmental impact of technical solutions.

General skills (from Computer Science Engineering studies)

- CG11 - Ability to analyze and assess the social and environmental impact of technical solutions, understanding the ethical and professional responsibility of the activity of the Computer Science Technical Engineer.

General skills (from Industrial Engineering studies):

- CG3 - Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
- CG6 - Ability to analyze and assess the social and environmental impact of technical solutions.

Cross-disciplinary skills:

- TRU1 - Analysis and synthesis capacity.
- TRU2 - Oral and written communication.
- TRU3 – Information management capacity.
- TRU4 – Self-learning.
- TRU5 – Teamwork.

Learning outcomes:

- RA1 - Ethical sensitivity: ability to identify and recognize ethical and social problems in the field of engineering.
- RA2 - Ethical analysis: ability to analyze ethical problems in terms of objective facts, values, conflicts of interest, and stakeholders.
- RA3 - Ethical creativity: ability to think about possible actions to be taken in the face of ethical conflicts in engineering.
- RA4 - Ethical judgment: ability to provide an ethical judgment in function of the different theories and ethical frameworks, including professional ethics and common sense.
- RA5 - Ethical decision making: ability to make decisions in the face of ethical conflicts in engineering.

3. CONTENTS

Module contents	Hours
Introduction and presentation	• 2 hours
Engineering as a profession	• 2 hours
Codes of ethics	• 2 hours
Normative ethics	• 4 hours
Ethical problem solving techniques	• 4 hours
Ethical aspects of technical risks	• 4 hours
The distribution of responsibilities	• 2 hours
Ethical design: deterministic algorithms	• 2 hours
Ethical design: cybersecurity, intellectual property, and privacy	• 2 hours
Ethical design: artificial intelligence and datasets	• 4 hours
Use cases (practical work at the laboratory)	• 12 hours

4. TEACHING METHODOLOGIES & LEARNING ACTIVITIES

4.1. Credits distribution (specified in hours)

Face-to-face class hours:	28 hours in large groups (2 hours x 14 weeks) 12 hours in small groups (2 hours x 6 weeks) 4 hours of projects presentations and evaluation
Number of student work hours:	106 hours, distributed as follows: • 24 hours of watching and analyzing multimedia material. • 82 hours of study and preparation of team works.
Total hours:	150 horas

4.2. Methodological strategies, teaching materials, and didactic resources

Theoretical sessions	Methodology: master classes where the teacher presents and explains the theoretical aspects, complemented by practical examples. Student participation will be encouraged from the theoretical concept developments, to the resolution of the proposed practical examples and the discussion of real cases. Resources: blackboard, audiovisual media, Internet, bibliography.
Practical problem solving sessions	Methodology: teamwork in groups of 2 people maximum. Initial explanation and general discussion of the practical case, collaborative work in each group with the guidance of the teacher, management and good use of the material, obtaining results, interpretation and presentation. Resources: board, audio-visual media, and laboratory equipment.
Tutorials and seminars	Individual and/or group tutorials on the theoretical and practical subject contents.
Other type of activities	Visualization and analysis of digital and multimedia material for the preparation of both theoretical and practical sessions. Learning through study, analysis of practical cases, bibliographic search and group work.

5. EVALUATION: Procedures, assessment criteria and grading system

Students will preferably be offered a continuous evaluation system that has formative evaluation characteristics, so as to serve as feedback in the teaching-learning process on the part of the student. For this the following procedures are established:

Evaluation procedures

1. **Ordinary Call:** the evaluation in the ordinary call must be inspired by the continuous evaluation criteria (regulatory rules of the Teaching Learning Process, NRPEA, art 3), always attending to the acquisition of the competences specified in the subject:
    a. **Continuous Evaluation:** It consists of carrying out and passing the proposed practical cases in small group classes, carrying out and passing an intermediate evaluation test, carrying out and passing a final group work and carrying out and passing a final exam. All this during the semester.
    b. **Final Evaluation:** It will consist of taking and passing a final exam. To take part in the final evaluation process, the student must apply in writing to the Director of the Polytechnic School within the first two weeks of joining, indicating the reasons that prevent the continuous evaluation system from being followed. The director of the Polytechnic School will communicate the resolution within a maximum of 15 days. If no reply is received, the request will be considered to have been accepted.

2. **Extraordinary Call:** students who have not passed the course in the ordinary call will have an extraordinary call, which will consist of a final exam. If the student opted for continuous assessment in the ordinary call, the score obtained in the evaluation of the practical cases in small groups and the final work will be taken into account.

Assessment Criteria

The evaluation criteria have to assess the acquisition level of the different skills by students. Accordingly, the following criteria are defined:

CE1: The student is able to identify and recognize ethical problems and social implications in the field of engineering.

CE2: The student knows diverse deontological codes in the field of engineering and is able to apply general and systematic approaches to ethical problems in engineering.

CE3: The student shows ability to analyze in detail the ethical problems from the point of view of the stakeholders and their interests.

CE4: The student knows the chain of responsibilities existing in the field of the professional performance of engineers and shows ability to propose diverse actions that consider the ethical and social dimension of the problem.

Means of evaluation

This section specifies the assessment instruments that will be applied to each of the Evaluation criteria.

1. Attendance and active participation in classes (AS).

2. Intermediate Evaluation Test (PEI): it will consist of a number of theoretical test-type questions, and development questions.

3. Resolution of practical cases (CP): passing the practical cases of the small group sessions, by means of the delivery of reports or resolution of multiple choice questions.

4. Group work (TG): carrying out a work on the subject, in group, and presentation in the classroom.

5. Final Evaluation Test (PEF): it will consist of several theoretical test questions and development questions.

Evaluation Criteria

This section quantifies the evaluation criteria for passing the subject.

Ordinary Call, Continuous Evaluation

The following table summarizes the relationship between learning outcomes, assessment
criteria, means of evaluation and their associated weights.

Skills	Learning Outcome	Assessment Criteria	Means of Evaluation	Weight in the final mark
All	RA1-RA5	CE1-CE4	AS	10
All	RA1-RA5	CE1-CE4	PEI	20
All	RA1-RA5	CE1-CE4	CP	25
All	RA1-RA5	CE1-CE4	TG	25
All	RA1-RA5	CE1-CE4	PEF	20

A student who follows the continuous evaluation procedure will be considered not to have taken the ordinary call if he or she does not take the Intermediate Evaluation Test (PEI).

The student will pass the continuous evaluation if he or she obtains an overall weighted mark higher than 5.

Convocatoria Ordinaria, Evaluación Final

Skills	Learning Outcome	Assessment Criteria	Means of Evaluation	Weight in the final mark
All	RA1-RA5	CE1-CE4	PEF	100

Convocatoria Extraordinaria

Skills	Learning Outcome	Assessment Criteria	Means of Evaluation	Weight in the final mark
All	RA1-RA5	CE1-CE4	PEF	40 / 100 (*)

(*) For those students who have been following the continuous evaluation in the ordinary call, the final weight of the final exam of the extraordinary call will be given by the following equation: max(PEF, 0.4PEF+0.1AS + 0.25CP+0.25TG).

6. BIBLIOGRAPHY

Basic bibliography:

- Lecture Notes elaborated by the teaching staff and provided via Blackboard.

Further reading:

- Ethics, Technology and Engineering: An Introduction. Ibo van de Poel and Lambèr Royakkers. Wiley-Blackwell. 2011.
- Engineering Ethics. Charles B. Fleddermann. E Source. 4th edition. 2012.
- Robot Ethics: The technical and social implications of robotics. Patrick Lin, Keith Abney and George A Bekey. MIT Press. 2012
- Robot Ethics 2.0: From Autonomous Cars to Artificial Intelligence. Patrick Lin, Keith Abney and Ryan Jenkins. Oxford university Press. 2017.
- Moral Machines: Teaching Robots Right from Wrong. Wendell Wallach and Colin Allen. Oxford university Press. 2009.
- Governing Lethal Behavior in Autonomous Robots. Ronald Arkin. Taylor & Francis Group. 2009.
- Engineering Ethics. Real World Case Studies. S. K. Starrett, A. L. Lara and C. Bertha. ASCE Press. 2017.
- Global Engineering Ethics. Heinz Luegenbiehl and Rockwell Clancy. Butterworth-Heineman, 2017.

Disclosure Note

The University of Alcalá guarantees to its students that, if due to health requirements the competent authorities do not allow the total or partial attendance of the teaching activities, the teaching plans will achieve their objectives through a teaching-learning and evaluation methodology in online format, which will return to the face-to-face mode as soon as these impediments cease.