

# **Impacts of Engineering: An Introductory Course in Engineering Featuring Social Justice**

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## **Abstract**

Impacts of Engineering is a three-credit required course for all incoming engineering freshmen and is also available as a general education elective to all university students. The course was developed to address the needs of new engineering students while setting the stage for how they might approach engineering work in later curriculum [1]. Prior to the development of this course, engineering students at UW-Stout were exposed to the topics of ethics, social justice, and social responsibility solely through general education electives and through limited discussion in capstone courses. In addition, there is a selection of “extra-curricular” opportunities for student engagement, most notably a chapter of Engineers Without Borders USA, however these opportunities don’t carry curricular integration. The first effort at more directly integrating these topics into the engineering curriculum was through the development of a new course called “Impacts of Engineering,” which is described in the course documentation as shown in the following section. Broadly, this course supports the program educational objective of graduating students who are “committed to high ethical standards, global perspectives, and principles of social responsibility and social justice.” [2, p. 207] The course aims to supplement the technical content typically found in introductory engineering coursework with professional or life skills such as good communication, time management, and ability to function on a diverse team. Finally, the course objectives include several that are specifically directed at developing an understanding of engineering design from a global perspective [3].

## **Curriculum Description**

A required first year engineering course at [University] was developed to address the needs of new engineering students while setting the stage for how they might approach engineering work in later curriculum. Broadly, this course supports the program educational objective of graduating students who are “committed to high ethical standards, global perspectives, and principles of social responsibility and social justice.” [2, p. 207] The course aims to supplement the technical content typically found in introductory engineering coursework with professional or life skills such as good communication, time management, and ability to function on a diverse team.

*Course description:*

A comprehensive study of the engineering design process from initiation to completion. Definition and history of engineering disciplines with comparisons among them. Investigation and exploration of past and present impacts of engineering on people, society, and the environment. Examination of contemporary and emerging issues related to engineering. Introduction to engineering in practice through engineering design projects.

*Course objectives:*

Successful completion of the course will enable students to:

1. Demonstrate an understanding of the historical philosophy of engineering and identify the effects of engineering design decisions throughout history.
2. Describe the various engineering disciplines and the differences between them.
3. Demonstrate an understanding of the comprehensive nature of engineering design.
4. Develop a systems perspective regarding the context of engineering design on a global scale.
5. Evaluate the ethical, social, economic, and environmental impacts of engineering during the design, production, and end user phase of a product's life from multiple perspectives.
6. Synthesize ethically, socially, and environmentally conscious design judgments and decisions.
7. Evaluate trends and future impacts of environmental and social consciousness and globalization on engineering design and manufacturing from multiple perspectives.
8. Demonstrate an experiential understanding of engineering design impacts relevant to the various engineering disciplines.
9. Apply basic calculation procedures and computational tools used in engineering.
10. Apply the engineering design process and employ it to solve real-world issues.

*Course outline:*

1. Engineering foundations
  - (a) Engineering design
  - (b) Engineering achievements and failures (Technologies and social, economic, and environmental unintended consequences)
2. Engineering disciplines
  - (a) Engineers as problem solvers
  - (b) Comparison of engineering disciplines
3. Engineering ethics

- (a) Codes of ethics across engineering disciplines
  - (b) Professional responsibilities as an engineer
  - (c) Case studies in ethical dilemmas
  - (d) Social justice engagement in engineering
4. Introduction to engineering design
- (a) The design process
  - (b) Technology and the market
  - (c) Effects of globalization on diverse populations
  - (d) Ethical, societal, and environmental concerns
  - (e) The future of engineering
5. Engineering design in practice
- (a) Social, economic, and environmental dynamics of project selection
  - (b) Developing engineering project specifications
  - (c) Calculations and computational tools
  - (d) Using the engineering design process in practice
  - (e) Solving real-world problems using the engineering design process
  - (f) Using value-sensitive design

## References

- [1] D. R. Berg and T. Lee, "Incorporation of Liberal Education into the Engineering Curriculum at a Polytechnic," in *2016 ASEE Annual Conference & Exposition*, New Orleans, LA, Jun. 2016.
- [2] J. A. Leydens and J. C. Lucena, *Engineering justice: Transforming engineering education and practice*. Wiley-IEEE Press, 2017.
- [3] T. Lacksonen, D. R. Berg, and S. Springer, "Global Engineering Projects from the Young African Leaders Initiative," in *2017 ASEE Annual Conference & Exposition*, Columbus, OH, Jun. 2017.