

## **ENTR 410/610: Acceptance and Resistance to Innovation**

**Fall 2021**

**TR 5:00-6:15 pm**

**Instructor:** Sujata K. Bhatia – Professor of Chemical & Biomolecular Engineering and Professor of Biomedical Engineering, University of Delaware

### **Description:**

This course will discuss the factors that influence societal acceptance of innovations, and will specifically address the social aspects of innovation and technological evolution. In order for an innovation to have impact, and in order for an entrepreneur to be successful, the innovation must gain acceptance within the broader society. Why are novel technologies readily accepted in some communities, yet resisted in other communities? In the course, students will learn through case studies of historical technologies such as the printing press, electricity, and farm mechanization, as well as contemporary and emerging technologies such as genetically modified foods, solar energy, nuclear power, cybersecurity, artificial intelligence, autonomous vehicles, and virtual reality. Some case studies will be inspired by, but not limited to, the Grand Challenges for Engineering as identified by the National Academy of Engineering. Students will thereby develop insights into society's most pressing needs; gain exposure to technologies from a variety of technical disciplines; and appreciate the social dimensions of each technology.

In this course, students will recognize that novel technologies can create both winners and losers in society, and will formulate strategies for maximizing beneficial impact, inclusivity, and societal acceptance of innovations. Since the ultimate goal of technology is to improve the quality of life for all, we must be cognizant of not only the technical feasibility of our designs, but also the social impact on humanity, as well as the environmental impact on our shared planet. Students will discuss the moral, ethical, social and cultural dimensions of the engineering innovations, as well as the technical and economic feasibility of engineering designs. Diverse students with a variety of interests and backgrounds outside of engineering will benefit from this course, including (but not restricted to) sociology, economics, philosophy, science, history, business, education, and public policy. This course will serve both engineering and non-engineering students, by providing a framework for students to evaluate the societal impact of novel technologies, reason quantitatively, and formulate inclusive strategies for overcoming resistance to new innovations.

### **Course Textbook:**

Calestous Juma, Innovation and its Enemies: Why People Resist New Technologies. Oxford University Press, New York, 2016.

## **Learning Goals:**

**By the end of this course, students will have the opportunity to:**

- **Identify the ethical, moral, and philosophical dilemmas posed by novel innovations. This includes wrestling with questions such as:**
  - **Are there potential unintended consequences, both short-term and long-term, of the technology?**
  - **How does the technology affect human agency?**
  - **How does the technology affect fundamental human rights?**
- **Identify the social and cultural dimensions of novel innovations. This includes wrestling with such questions as:**
  - **Does the technology meet the needs of a diverse and growing global population?**
  - **Who are the winners and losers? Are there any groups that have been overlooked?**
  - **Will the innovation exaggerate or eliminate social disparities? Will this technology benefit a few or benefit everyone? If it benefits only a few, does it do so at the expense of others?**
- **Evaluate the risks and benefits of novel technologies, and how the risk/benefit ratio may change over time. Identify any possible uncertainties in technological development.**
- **Discuss whether a technological solution is always the best solution to an unmet need.**
- **Debate how criteria such as scientific advancement, economic empowerment, international development, environmental protection, and public health should guide society in setting priorities for technological investment.**
- **Identify potential sources of misconceptions regarding new technologies.**

**By the end of the course, students will generate visionary concepts for novel technologies to address global grand challenges in energy, sustainability, food, nutrition, and healthcare, and will develop strategies for overcoming societal resistance to these innovations.**

**Each class session will also include class discussions, case studies, and student presentations of journal articles.**

## Lecture Schedule:

### Weeks 1 and 2 –

**Reading:** Innovation and its Enemies, Chapters 1 and 2

Kaebnick, G. et al. 2016. "Precaution and Governance of Emerging Technologies," *Science* 354 (6313): 710-711.

Fischhoff, B. 2015. "The Realities of Risk-Cost-Benefit Analysis," *Science* 350 (6260): 1-7.

- Week 1 - The Innovation Ecosystem and Creative Destruction  
It is not uncommon to see those opposed to new technologies being dismissed as luddites or ignorant opponent of innovation. This session rejects this view and outlines the main reasons that underlying opposition to new technologies.

**Discussion questions:**

What are the common explanations for opposition to new technologies?

What are the deeper reasons for negative responses to new technologies?

- Week 2 - Coffee Brewing Technology, Coffeehouses, and Social Change  
Technological innovation coevolves with social institutions in unpredictable ways. This session outlines the sources of resistance to new technologies. It uses history controversies surrounding the introduction of coffee.

**Discussion questions:**

What methods have been used to oppose coffee through history?

What factors explain the global adoption of coffee?

What lessons from the case of coffee can be applied to contemporary controversies?

### Weeks 3 and 4 –

**Reading:** Innovation and its Enemies, Chapters 3 and 4

Turvey, C. and Mojduszka, E. 2005. "The Precautionary Principle and the Law of Unintended Consequences," *Food Policy* 30(2): 145-161.

- Week 3 - Resistance to the Printing Press  
The printing of the Koran was prohibited in the Ottoman Empire for nearly 400 years. This session examines the reasons for prohibition and uses them to identify similar similarities in contemporary society.

**Discussion questions:**

What underlying reasons informed opposition to the printing of the Koran?

What reasons explain the decision to eventually allow the printing of the Koran?

How can the lessons from this case inform modern debates over new technologies?

- Week 4 - Margarine vs. Butter  
Margarine was invented in France and initially commercialized in Europe. But its introduction in the United States faced still opposition from the dairy industry. This session examines the sources of the opposition of the emergence of new institutional organizations designed to lobby government.

**Discussion questions:**

What tactics were used to slow down the adoption of margarine?

What explains the final success in the adoption of margarine?

What lessons can contemporary society learn from the margarine debate?

## Weeks 5 and 6 –

**Reading:** Innovation and its Enemies, Chapters 5 and 6

Wiens, K. 2015 “We Can’t Let John Deere Destroy the Very Idea of Ownership,” *Wired*, <https://www.wired.com/2015/04/dmca-ownership-john-deere/>

- **Week 5 - Farm Mechanization**  
The early mechanization of American agriculture was associated with extensive public controversies that lasted decades. Similar debates about farm mechanization continue in other parts of the world. This session analyzes the root causes of the controversies and their dynamics.  
**Discussion questions:**  
How was opposition to farm mechanization organized?  
What explains the eventual triumph of tractors over farm animals?  
How can the lessons of the debate be applied to contemporary debates?
- **Week 6 – Electricity**  
Not all cases of opposition to new technology seek to exclude new players from entering the market. This session uses the case of electrification to explore how incumbent players oppose new technologies to buy time to exist the industry.  
**Discussion questions:**  
What methods did Edison employ to oppose the use of alternating current?  
What were they features that contributed to the success of alternating current?  
What lessons can modern society learn from the “war of the currents”?

## Weeks 7 and 8 –

**Reading:** Innovation and its Enemies, Chapters 7 and 8

Thompson, C. 2016 “How the Phonograph Changed Music Forever,” *Smithsonian Magazine*, <http://www.smithsonianmag.com/arts-culture/phonograph-changed-music-forever-180957677/>

- **Week 7 - Mechanical Refrigeration**  
Mechanical refrigeration dramatically impacted the cold storage industry and made modern urban life possible. This session explores how expert advice makes technological improvements possible, so that mechanical refrigeration could overcome objections raised by the natural ice industry.  
**Discussion questions:**  
How do shifting demographics such as urbanization affect technology adoption?  
How is technology adoption influenced by perceptions of safety and natural vs. artificial?  
In what ways is a trade association an institutional innovation?
- **Week 8 - Recorded Sound**  
The conflict between innovators and organized labor is of the key features of technologies controversies. This session uses the examples of bans on recorded music to explore the relationships between labor and innovation.  
**Discussion questions:**  
What methods did organized labor use to restrict the adoption of recorded music?  
Why did organized labor in the end fail to stop music recording?  
What can modern society learn from the case of the music bans?

## Weeks 9 and 10 –

**Reading:** Innovation and its Enemies, Chapters 9 and 10

Kanchiswamy, C.N. et al. 2015. "Looking Forward to Genetically Edited Fruit Crops," Trends in Biotechnology 33(2): 62-64.

Voytas, D.F. and Gao, C. 2014. "Precision Genome Engineering and Agriculture: Opportunities and Regulatory Challenges," PLOS Biology 12(6): 1-6.

- Week 9 - Transgenic Crops  
Much of the opposition to new technologies is fueled by perceptions of market loss. This is illustrated by the examples of transgenic crops. This session uses the case of transgenic crops to explore the role of incumbent industries in stalling the adoption of the products.  
**Discussion questions:**  
What are the economic sources of opposition to transgenic crops?  
Who are the key actors in the opposition to transgenic crops?  
What lessons can we learn from the debate over transgenic crops?
- Week 10 - AquAdvantage Transgenic Salmon  
Building on the lessons from transgenic crops, this session examines the regulatory history of transgenic salmon in the United States. It examines the role that different actors played in seeking to curtail its commercialization.  
**Discussion questions:**  
What are the origins of opposition to transgenic fish?  
What arguments have been used to challenge the adoption of transgenic fish?  
What lessons from the transgenic fish debates are relevant for other technologies?

## Weeks 11 and 12 –

**Reading:**

Innovation and its Enemies, Chapter 11

National Academy of Engineering. 2008. Grand Challenges for Engineering, National Academy of Sciences, Washington, D.C. (pages 1-56)

- Week 11 - The Grand Challenges for Engineering  
This session outlines global grand challenges facing humanity and explores how technological innovation could provide some of the solutions. Emphasis is placed on sustainability, healthcare, energy, food, and education.  
**Discussion questions:**  
What do you consider to be the most pressing global challenges?  
What are possible technologies that could be used to address the challenges?
- Week 12 - Oiling the Wheels of Novelty  
Science and technology advice is an essential input into the process of public debate over biotechnology. This session reviews key aspects of public policy that are needed to social concerns over new technologies.  
**Discussion questions:**  
What are some of the key policy measures that can be used to address public concerns over new technologies?  
What kinds of institutional innovations are needed to facilitate technology adoption?

## **Week 13 – Final Presentations (in class)**

### **Course Policies and Expectations**

- Students are expected to attend and actively participate in every class session, including asking and answering questions and contributing to class discussions.
- Any material submitted to meet course requirements is expected to be a student's own work.

### **Grading Procedures:**

Class Participation: 50%

Final Presentation: 50%

### **Assignment and Reading Details:**

For this course, all students are expected to complete the assigned readings and participate actively in class discussions by asking questions and offering ideas. For the final presentation, students are expected to each choose an emerging technology and present the history, social acceptance, and social resistance to the innovation, as well as strategies for overcoming resistance.