

**Engineering Division Course Syllabus**

**Course Title: Design and Innovation**

**Course Number: ENGR-AD 110**

**Course Description:** The course introduces students to the history and culture of design and development philosophies and practices, the modern principles of technology design, and concepts of innovation, sourcing, shaping and evaluating ideas and inventions. The labs emphasize experiential learning and innovation, and require students to use existing innovations to create and build prototypes of new technology/ design products, with real-life constraints.

**Course Hour/Week**: Immersive, 2.5 weeks experience involving lectures and significant laboratory work.

**Course Credit:** 2 credits

**Course Category:** Engineering Foundations Core

**Prerequisite**: None

**Lecturer/Lecturers**: Professor Ramesh Jagannathan, email: [rj31@nyu.edu](mailto:rj31@nyu.edu), Professor Stefan Agamanolis, stefan@agamanolis.com

**Course Teaching Objectives:** The objectives of the course are:

* To familiarize students with the concepts and practices of technology innovation, product design and modern research and development practices.
* To establish an understanding of the fundamental principles guiding the product design process and their evaluation in terms of three essential value propositions namely, customer, technology and business.
* To develop an understanding of the role of design in innovation as a collaborative, multi-disciplinary team activity.
* To examine and understand the evolution of the innovation processes over the last six decades and their future.
* To improve skills of presentation and report writing on technical and feasibility studies

**Course Learning Outcomes:** The following learning outcomes are anticipated upon completion of this course. Students will be able to:

* Identify and apply the process of innovation and design (assessed by homework assignments, final paper, and laboratory projects) [(m.1), (m.2), (m.3)].
* Design and construct a system within realistic constraints (assessed by homework assignments, final paper, and laboratory projects) [(c.3), (k.2)] .
* Work effectively as team members and demonstrate leadership skills (assessed by laboratory projects) [(d.1), (d.2), (d.3), (l.1), (l.2), (l.3)].
* Communicate effectively (assessed by laboratory and project reports and presentations) [(g.1), (g.2)].

**Text Book:** The Design of Business, Roger Martin, Harvard Business Press (2009)

**References:**

1. Change by Design, Tim Brown, Harper Business (2009)
2. The Art of Innovation, Tom Kelley, Currency Doubleday (2000)
3. Designing Interactions, Bill Moggridge, The MIT Press (2007)
4. Design Thinking, Edited by Thomas Lockwood, Allworth Press (2010)
5. What I Wish I Knew When I Was 20, Tina Seelig, Harper One (2009)

**Teaching Method:** Primarily a team based “Super Lab” method complemented with lectures. The student teams will work in an immersive fashion to conceptualize a technique involving an electronic product, comprising “soft and hard electronic” sensors and actuators, such as smart fabrics, and robots, to communicate one emotion over long distance. Students will be taught the basic skills in brain storming, circuits and coding and would be charged to shape and develop their ideas and system integrate them into a functional proto-type through a self-learning process. The professors and their assistants would serve as coaches throughout the process and serve as a sounding board.

**Evaluation:** Students will be graded as follows.

1. Initial Project and Writing Assignments 25%
2. Class Projects and Team Work 25%
3. Final Project 50%
4. Total 100%

**Lecture Topics:**

1. Design and Innovation Practices (2.0 hours)
2. Design and Innovation Criteria and Value Creation (2.0 hours)
3. Innovation Funnel, Design Thinking, Circle Model (2.0 hours)
4. Heuristic Processes, Algorithms (1 hours)

5. Brain Storming Exercises (1 hours)

Total (8 hours)

**Related Laboratory Exercise**

1. Super lab Design Project (54 hours)

**Relationship to Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Shared Engineering Outcomes | | | | | Program Specific Criteria | | | | |
|  | (1) | (2) | (3) | (4) | (5) | CivE | CmpE | ElecE | MechE | GenE |
| Lectures | x | x |  | x | x | x | x | x | x | x |
| Labs | x | x |  | x | x | x | x | x | x | x |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Student Learning Outcomes | | | | | | | | | | | | |
|  | (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) | (k) | (l) | (m) |
| Lectures |  |  | x | x |  |  | x |  |  |  | x | x | x |
| Labs |  |  | x | x |  |  | x |  |  |  | x | x | x |

**Shared Engineering Outcomes:**

(1) Apply techniques in the practice of leadership and innovation [(l), (m)];

(2) Identify social, economic, ethical and other factors that shape engineering solutions and incorporate them in conjunction with engineering principles in problem solving and designing systems, components, or processes to meet desired needs within realistic constraints [(a), (c), (e), (f), (h)];

(3) Recognize and respond respectfully to cultural concerns and differences when solving problems both physical and ethical [(a), (e), (f), (h)];

(4) Exhibit guidance and organizational effectiveness in multidisciplinary teams as a participant and a leader [(d), (l)];

(5) Demonstrate competence in writing and speaking effectively, and in communicating significant technical information in a clear and concise manner [(g)].

**Program Specific Criteria:**

* CivE: Civil Engineering graduates will be able to work professionally in four of the technical areas of the civil engineering discipline (structural, geotechnical, transportation, and environmental), design systems, components, and processes in more than one civil engineering context, and apply the principles of project management.
* CompE: Computer Engineering graduates will be able to analyze and design complex computing and network devices and systems containing hardware and software components.
* ElecE: Electrical Engineering graduates will be able to analyze and design complex electrical, electronic, and communication devices and systems.
* MechE: Mechanical Engineering graduates will be able to analyze and design systems, components, and processes, and work professionally in both thermal and mechanical systems areas.
* GenE: General Engineering graduates will be able to analyze and design devices and systems in an interdisciplinary engineering area related to: Biomedical and Health Systems; Information, Communication, and Electronic Systems; or Urban Systems.

**Student Learning Outcomes:**

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multidisciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

(l) an ability to apply leadership skills including project and risk management and decision making

(m) an ability to apply innovation skills

**Assessment Plan for ENGR-AD 110: Design and Innovation**

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| --- | --- | --- | --- |
| **Performance Indicators** | **Assessment Tools** | | |
| **Project Presentation** | **White Paper** | **Design Project** |
| **(c.3) Design a system/process to meet desired needs within realistic constraints.**  *The students were tasked with conceptualizing an innovative electronic product to communicate one emotion or an experience over long distance.* |  |  | **x** |
| **(d.1) Fulfill individual duties.** |  |  | **x** |
| **(d.2) Contribute to the team effort.** |  |  | **x** |
| **(d.3) Consider viewpoints of team members.** |  |  | **x** |
| **(g.1) Demonstrate effective written communication of information, concepts and ideas.**  *Deliver a research, white paper.* |  | **x** |  |
| **(g.2) Demonstrate effective oral presentation of information, concepts and ideas.**  *Deliver a team presentation at the end of the course.* | **x** |  |  |
| **(k.2) Acquire skills using modern laboratory tools necessary for engineering practice.**  *Ability to use necessary electronic and software tools to complete the design* |  |  | **x** |
| **(l.1) Apply principles of project management**  *Students are expected to use standard project management techniques with special emphasis on customer feedback.* |  |  | **x** |
| **(l.2) Apply techniques of risk assessment in decision making**  *Ability to identify and manage risks associated with the development of the innovative design.* |  |  | **x** |
| **(l.3) Demonstrate effective decision making within contextual constraints**  *The students will demonstrate the ability to conceptualize the abstract concept and convert it into a tangible deliverable within tight time and budget constraints.* |  |  | **x** |
| **(m.1) Frame a problem creatively** |  | **x** |  |
| **(m.2) Leverage state-of-the-art technology**  *Students incorporate modern electronic sensors including soft electronic sensors and wireless communication devices.* |  |  | **x** |
| **(m.3) Optimize value proposition**  *Maximize the impact of the design on the end user.* |  |  | **x** |
| **CivE: *Criteria satisfied by outcomes above and degree curricular requirements*** | | | |
| **CompE: *Criteria satisfied by outcomes above and degree curricular requirements*** | | | |
| **ElecE: *Criteria satisfied by outcomes above and degree curricular requirements*** | | | |
| **MechE: *Criteria satisfied by outcomes above and degree curricular requirements*** | | | |
| **GenE: *Criteria satisfied by outcomes above and degree curricular requirements*** | | | |