New York City College of Technology
Department of Career and Technology Teacher Education

Course Number: **EDU-4480**
Credit Hours: 3
Instructor: Euisuk Sung
Office: P-513
Office Hours: Monday 1:00-4:00 pm

Title: **Principles of Engineering**
Class Meeting Times: Monday 4:15 – 7:35pm
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COURSE DESCRIPTION

This course is a laboratory-based capstone course designed to enable the student teacher to study the relationship among mathematics, science and engineering. Focus is on the integration of the content of these disciplines into the secondary school technology curriculum and to stimulate student interest in pursuing engineering and technology careers.
Prerequisites: MAT 1375 or higher, PHYS 1112 or PHYS 1434 or PHYS 1442

COURSE OBJECTIVES

The following objectives will be connected directly to the assignments on a weekly basis to increase your awareness of the purpose and intention behind assignments.
Upon completion of the course, students will be able to:

1. Identify real-world problems that need to be solved using technological and engineering design.
2. Conduct design research to inform inventions and innovations that address specific needs and wants.
3. Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.
4. Use conceptual, graphical, virtual, mathematical, and physical modeling to demonstrate the design solution.
5. Develop design solutions using advanced technological tools to solve the identified problem.
6. Apply a broad range of making skills to their design process
7. Assess design solutions using design criteria and constraints.
8. Document the engineering design process using an online portfolio platform and share the final design to the public.

Interstate Teacher Assessment and Support Consortium's (InTASC) Model Standards

1. **Learner Development** –understands how learners grow and develop, and designs and implements developmentally appropriate and challenging learning experiences.
2. **Learning Differences** –uses understanding of individual differences, diverse cultures and communities to ensure inclusive learning environments that support learners of all abilities, backgrounds, or learning styles.
3. **Learning Environments** –creates collaborative learning environments that encourage positive social interaction, active engagement in learning, and self-motivation.
4. **Content Knowledge** –understands the central concepts, tools of inquiry, and structures of discipline(s) and uses these to engage students in meaningful learning experiences.
5. **Application of Content** –connects concepts and uses differing perspectives to engage learners in real-world problem solving.

6. **Assessment** –uses multiple methods of assessment to engage learners in their own growth, to monitor learner progress, and to guide pedagogical and assessment decisions.
7. **Planning for Instruction** –plans instructions upon understandings of knowledge of content areas, curriculum, cross-disciplinary skills, and pedagogy.
8. **Instructional Strategies** –uses appropriate instructional strategies to encourage learners to develop deep understanding of content areas and interdisciplinary connections, and to build skills to apply knowledge in meaningful ways.
9. **Professional Learning and Ethical Practice** –engages in ongoing professional learning and uses evidence to continually evaluate his/her practices to meet the needs of each learner.
10. **Leadership and Collaboration** –takes appropriate leadership roles and opportunities to take responsibility for student learning, to collaborate with learners, families, colleagues, other school professionals, and community members to ensure learner growth and to advance the profession.

REQUIRED TEXT AND MATERIALS

1. No textbook.
2. Arduino (microcontroller)
3. Capstone design project materials (depend on your project)

OTHER INSTRUCTIONAL RESOURCES

1. New York State Education Department. *Communication Systems Curriculum Guide*. Available: http://www.p12.nysed.gov/cte/docs/COMMUNICATIONSYSTEMS.pdf
2. International Technology and Engineering Education Association. (2000/2003/2007). Standards for Technological Literacy. https://www.iteea.org/File.aspx?id=67767&v=b26b7852
3. Instructables - https://www.instructables.com/

ATTENDANCE/PARTICIPANTION

- You will earn 10 points per class within the following guidelines. This policy begins at the second class.
- 10 points awarded for students who are on time, stay on task, contribute to the overall class discussions, and complete all required activities during each class.
- 9-1 points awarded for students who arrive late, do not stay on topic, and come to class unprepared to conduct the lab activity.
- 0 points awarded for absence from class.
- Students are allowed no more than two (2) absences.
- Only excused late attendances will be allowed, but they may not exceed 30 minutes.

Please Note: **The instructor has the right to award any point value between 1-10 following the above guidelines.**

EXCUSED ABSENCE

- An excused absence must be pre-approved by the instructor
- Medical absences will only be awarded when the student provides a Drs. note and based upon appropriate situations.
- Only documented emergencies or unavoidable events will be excused.

EVALUATION

A. Evaluation Criteria:

Class Participation/Attendance	100 pts
Essay assignment (What is engineering?)	100 pts

Weekly Lab Report, 4 posts, 50 pts each	200 pts
Online Portfolio	200 pts
Final Project	300 pts
Final Presentation	100 pts
TOTAL	1000 pts

* Changed points and/or content due to the transition into distance learning

B. Grading System

1000-930: A	929-900: A-	899-870: B+	869-830: B	829-800: B-
799-770: C+	769-730: C	729-700: C-	699-600: D	Below 600: F

C. Weekly Lab Report

Each student should upload the lab report after each lab activity. The lab report should include the process of your activities, outcomes, and a reflection on your work.

D. Online Portfolio.

Each group of students will need to create an online portfolio website to record your project progresses and outcomes. This class recommends you to use the Google Sites platform for your online portfolio. Watch the video "How to create an online portfolio site on Google Sites"

TEAMWORK

The majority of lab activities in this class (and much of what you do for the rest of your life) will be done in teams. As such you will receive a *teamwork score* at the conclusion of each team assignment.

SAFETY

1. All safety procedures and rules outlined are applicable to members of this class.
2. Approved eye protection devices must be worn at all times when using any of the power equipment in the laboratory setting, if applicable.
3. Hearing protection will also need to be worn along with eye protection in the lab.
4. **No food or drink should be brought into the fabrication lab**.
5. After a lab activity, all students are responsible for cleaning up the lab.
6. If you are not confident in using a certain machine or tool, you should immediately stop using it and report to the instructor. This will not hurt your grading.

STUDENTS WITH SPECIAL NEEDS

Qualified students with disabilities will be provided reasonable academic accommodations if determined eligible by the Office of Students Support Services (OSSS). Prior to granting disability accommodations in this course, the instructor must receive written verification of a student's eligibility from OSSS, which is located in Room A-237. It is the student's responsibility to initiate contact with the OSSS staff and to follow the established procedures for having the accommodation notice sent to the instructor.

CONTENT OUTLINE

1. **Introduction to engineering design**
   1.1. What is engineering, design, and engineering design?
   1.2. Thinking about human-centered design
   1.3. The engineering design process
   1.4. Engineering method

2. **Physical Fabrication**
   2.1. Woodworking tools
   2.2. Fabrication practices
   2.3. Design a wood product

3. **Digital Fabrication**
   3.1. Arduino Basic
   3.2. Controlling Arduino using C
   3.3. Digital & Analog control
   3.4. 3D printing & CAD
   3.5. Laser cutting

4. **Capstone Design Project**
   4.1. Problem Identification
   4.2. Research on the problem
   4.3. Develop solutions
   4.4. Present and assess the solution.

Weekly schedule (as of 5/7/2020)

Week	Date	Topics	Pre-Class Assignment	In Class Activities & Assignments
1	8/31	Intro to the EDU 4480.	Read course syllabus	Syllabus Review and class policy
2	9/14	Introduction to engineering design	Read articles Engineering, Design, and Engineering Design (Sung, 2020)	Discuss what and why questions related to engineering, design, and engineering design. **[Essay Assignment]** What is engineering design? So what?
3	9/21	Physical Fabrication 1	Watch lab safety video	Discuss lab safety roles Demonstrate woodworking tools Design a wood product **[Lab report 1]** post your design on your online portfolio
4	9/29	Physical Fabrication 2	Review your design	Build the wood product (1/2)
5	10/5	Physical Fabrication 3	Plan for your making project	Build the wood product (2/2) **[Lab report 2]** Post your project report on your online portfolio.
6	10/14	Digital Fabrication 1	Watch Arduino Intro video	- Setup Arduino development environment. - Analog input/output practices
7	10/19	Digital Fabrication 2 - Arduino Advanced	Research the capability of Arduino of what we can do using Arduino. **[Lab report 3]** Post the research results on your online portfolio	- Discuss Arduino projects - Explore Arduino project ideas.
8	10/26	Digital Fabrication 3 - 3D printing & Laser cutting	Watch 3D Printing & Laser Cutting intro videos	- Quick 3D design & print on 3D printer - Demonstrate laser cutting - Discuss the capabilities of 3D printer & laser cutter **[Lab report 4]** Post the research outcomes on your online portfolio
9	11/2	Capstone design project	Read articles - Engineering Method (Lasser, 2013)	- Team building - Build group norms

		- Team building & research methodology	- Engineering Design Process (Sung, 2020)	- Capstone research techniques
10	11/9	Capstone design 1	- Problem identification & ideation	
11	11/16	Capstone design 2	- Ideation & solution development	
12	11/23	Capstone design 3	- Develop the selected solution **[Assignment]** Project progress report on online portfolio	
13	11/30	Capstone design 4	- Develop the selected solution	
14	12/7	Capstone design 5	- Develop the selected solution **Project Final due Dec 7 11 pm**	
15	12/14	**Final Presentation**		

Capstone Design Project

1. Philosophy of this course: Each team will run similarly to the way a business would run their product development teams. This course will use a student-centered approach where we will abandon the familiar "lecture/homework/exam" format that you are familiar with this. Students will need to engage in more team participations and hands-on approach to learn where you become a problem solver rather than a knowledge consumer. By designing new products, you will expand your knowledge and skills in 21st century skills: communication, collaboration, critical thinking, and creativity with research skills including scientific inquiry, engineering design, and technological problem-solving. Also, this course will help you develop creative thinking skills by practicing brainstorming; new concept generation, screening and selection; developing solution, and assessing your solution. As you develop your project, you will need to document all the process of designing on your online portfolio platform with notes and reflections.
2. You are problem solver. This course will not provide any specific problem context but will ask you to find a problem where you reside in. The problem you defined could be ambiguous and even hard to define what it is. However, this process is very natural and will help you to develop the ability that manages unfamiliar situations.
3. Solution development. This capstone design project has one technical limitation that you must use at least one piece of 3D printed part and programmable microcontroller. This constraint will help you develop digital fabrication techniques which will be essential to teach advanced technologies to young students.
4. **Evaluation Criteria (200 pts)**
    a) Problem Definition (50 pts)
        a. Problem is important in context of the assignment, and considers issues of social, economic, or environmental equity.
        b. Problem is specific, challenging, and can be investigated given available resources,
    b) Exploration (50 pts)
        a. Describes multiple aspects of design based on research, testing, or reverse engineering
        b. Considers multiple metrics that align with each criterion and constraints and justifies selection of the most valid metrics.
    c) Design Prototype (50 pts)
        a. addresses the problems identified at the problem identification stage.
        b. considers realistic constraints and issues.
        c. effectively work to help vulnerable people
    d) Documentation (50 pts)
        a. Appropriately detailed and structured for the intended purpose.
        b. Include all necessary specifications
        c. Contain the process of the development of the design prototype.
5. **Due: Dec 7**
6. **Submission Materials**
    a. Online project portfolio.
    b. Presentation PPTs
    c. Solution model & demonstration.

Your Name (print) _____

EDU 4480 Principles of Engineering
Semester Fall 2020

ACADEMIC INTEGRITY

Students and all others who work with information, ideas, texts, images, music, inventions, and other intellectual property owe their audience and sources accuracy and honesty in using, crediting, and citing sources. As a community of intellectual and professional workers, the College recognizes its responsibility for providing instruction in information literacy and academic integrity, offering models of good practice, and responding vigilantly and appropriately to infractions of academic integrity. Accordingly, academic dishonesty is prohibited in The City University of New York and at New York City College of Technology and is punishable by penalties, including failing grades, suspension, and expulsion.

STUDENT CONDUCT POLICY

The general policy on student conduct is stated above in the bylaws of the board of trustees of The City University of New York, Article XV Student Conduct Regulations. Students who are enrolled in City Tech are obliged to conduct themselves in a manner that is in keeping with the functions of the college as an educational institution. Therefore, violations of any of the college regulations are subject to disciplinary action. Infractions of the regulations include but are not limited to the following:

1. Any behavior (physical or verbal) that interferes with the college's educational objectives or is harmful to the safety of the City Tech community. This includes but is not limited to excessive noise, disorderly, lewd, indecent or obscene conduct or expressions, inappropriate intimate behavior, disruptive conduct in the classroom and hazing or harassment of students for the purposes of initiation into a fraternity, sorority or other college clubs.
2. The use of cellular phones in academic and study areas of the college including but not limited to classrooms, libraries, laboratories, learning centers and auditoriums. Students are not permitted to take calls or send or receive text messages during class or to leave the classroom during scheduled class time to conduct a conversation.
3. Improper use, destruction, or unauthorized removal of college property and/or the property of others.
4. The unauthorized possession of regulated drugs; the possession, use and sale of illegal drugs on the grounds and/or facilities of the college.

I, _____, have read and agree to the terms set forth in the EDU 3410 syllabus. I understand that the instructor has the right to change the syllabus at any time with notice to the class. This syllabus serves as a contract between the instructor and the student. By signing the contract, I am stating that I am aware of all policies and will adhere to them.

Signature _____

LAB ACTIVITY GRADING SYSTEM

Category	Level 1	Level 2	Level 3	Level 4	Level 5
Project quality	(10) Absent/missing	(24) Student disregards details and work is sloppy; improver tools, materials, and processes were used on majority of project; minimum effort shown;	(26) Details were overlooked and project lacks quality; proper tools, materials, and processes were used on half of the project	(28) Meets expectations for students' skill level; Not superior, but advanced quality and attention to detail evident; proper tools, materials, and processes used on majority of project	(30) Exceeds expectations; Superior quality and attention to detail is evident; proper tools, materials, and processes used to entire project;
Lab Report	(5) Absent/missing	(14) Some of process, technique, knowledge, and reflection learned from the project are recorded; but minimum effort shown	(16) The process, technique, knowledge, and reflection learned from the project are recorded; but some are missing; but little effort shown	(18) The process, technique, knowledge, and reflection learned from the project are recorded, and some are missing	(20) The process, technique, knowledge, and knowledge learned from the project are recorded.
Bonus points					
Originality and creativity	(+0) Absent/missing	(+2) Student adapts existing ideas, but little was modified	(+3) Student adopts existing ideas, but modified some; limited originality shown	(+4) Student adapts existing ideas, but modified to create his/her own design; some originality shown	(+5) Now and innovative approach to the topic; student has created own design and product

Note: The total score of each project does not exceed 50 points.