**VA455/555 – Physical Computing**

**Instructor**: Selçuk ARTUT, Ph.D. in Media Communications

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**Class Hours:** 12:40 pm - 3:30 pm Tuesdays

**Course Description**

This course explores various methods and design systems for collaboratively applying physical computing while building an interactive physical environment with basic prototyping. The basics of building circuits and developing software to communicate with microcontrollers and embedded systems will be introduced. Students enrolled in this course will be expected to work in teams to design and build a project that explores the ideas and technology that fall into the realm of physical computing. Contribution to the team project, class discussions, and project reviews are essential.

**Keywords**: Embedded Systems, Circuit Design, Human-Technology Interactivity, Sensor Reading, Communication Protocols, Haptic Design, Assistive Technologies, 3D Printing / Prototyping

**Learning Outcomes**

. Understand the importance of prototyping in interaction design

. Find possible hardware and software to use in prototypes of computational things

. Understand basic technical specifications of electronic components

. Perform basic programming of micro-controllers connected to sensors and actuators of various kinds

. Handle communication between microcontrollers and ordinary computers

**Software**:

- Arduino IDE

- Autodesk Fusion 360 – 3D Printing

- Thinkercad

**Textbook (recommended):**

- Online resources will be provided

**Video Tutorials:**

- Fusion 360 - Basic Part Modeling

- Fusion 360 - 3D Printed Product Enclosure

- Fusion 360 - Essential Training

**Grading Policy:** 50% Design Challenges + % 20 Final Project + %10 Final Project Progress + 10% Quiz + 10% Attendance and Participation (3 misses loses all)

**Disclaimer:** We may have to revise the course plan according to the reassessment to be made country-wide, regarding higher education, at the beginning of April. The content to be delivered is certain but the method of course delivery, the number and dates of exams, and some other details are subject to change.

Weekly Schedule Tentative

Week 1: Introduction, Course Objectives, Students’ Expectations   
[28.02.2023]

Motivation

Introduction to Physical Computing Course

Week 2: Introduction to Prototyping with 3D Printing   
[07.03.2023]

Basics of 3D Modelling

Video Tutorials/Introduction (available in sucourse)

1-What Fusion 360 does

2-What Fusion 360 does not do

3-Fusion 360 competitors and companions

4-The online aspect of Fusion 360

5-Browser-based CAD

6-Team and client collaboration

7-What is covered in this course

8-What is not covered in this course

Creating Basic Shapes

Video Tutorials/02-Creating Basic Shapes (available in sucourse)

1-Introduction to creating basic shapes

2-Fusion 360s environments

3-Environments – Designing

4-Environments – Showing

5-Environments – Making

6-User interface refresher

7-Lets create some primitives

8-An intro to sketching

9-Sketch dimensions explained

10-Extruding profiles to create objects

11-What is lofting?

12-Setting up your Loft profiles

13-Lofting and controlling tangency

14-Adding loft guide rails

15-What are Sweeps

16-Fusion 360 can sculpt?

17-What is surface modeling?

**Extra Video Tutorial:** Fusion 360 Essential Training (available in sucourse)

**Quiz 1:** Introduction to Prototyping with 3D Printing

**Assignment: Design Challenge One:** Designing a box with a hinge

Week 3: Planning your design, Editing Shapes, Inspecting and Creating Your Work  
[14.03.2023]

Video Tutorials/ 03-Planning Your Design (available in sucourse)

1-Planning the process

2-Take a step back

3-Now get close and start drawing

4-Overview of the timeline

5-Editing via the timeline

6-Why create user parameters?

7-Timeline editing caveat- Sculpting

8-The importance of edges

9-The importance of cleanliness

Video Tutorials/ 04-Editing Your Shapes (available in sucourse)

1-Intro - Modify and assemble tools

2-Making shapes useful

3-Making shapes nice

4-Combining shapes

5-Use patterns

6-Sculpt edges and editing

Video Tutorials/ 05-Inspecting and Creating Your Work (available in sucourse)

1-Analysis tools

2-Analysis tools 2

3-Measurement tools

4-Exporting solid models

5-Exporting polygonal models

**Quiz 2:** Planning your design, Editing Shapes, Inspecting and Creating Your Work

**Assignment: Design Challenge Two:** Designing a soap holder

Week 4: Solid Modelling, Sculpt Modelling  
[21.03.2023]

Video Tutorials/ 06-Solid Modelling Tutorial - Headphone Hanger (available in sucourse)

1-Introduction to the step-by-step section

2-Introduction to planning your model

3-Strategy: Inside-out

4-Strategy: Outside-in

5-Using paper, pencil, and a ruler

6-Translating your design into a sketch

7-Alternate: Uploading an image template

8-Sketch and extrude the starter profile

9-Creating a baseplate

10-Create and extrude your aesthetic curves

11-Bonus - Sweeping a lip

12-Beauty through embellishments and fillets

Video Tutorials/ 07-Sculpt Modeling Tutorial - Headphone Hanger (available in sucourse)

1-Introduction to sculpting the hanger

2-Importing your template

3-Sculpting a plane and editing the form

4-Surface thickening the hanger portion

5-Sketch and extrude a sculpted baseplate

6-How to patch and stitch surface models

7-Cutting holes and making it pretty

**Quiz 3:** Solid Modelling, Sculpt Modelling

**Extra Video Tutorial:** Fusion 360 - 3D Printed Product Enclosure (available in sucourse)

**Assignment: Design Challenge Three:** Designing an enclosure for Arduino Uno

Week 5: Breaking apart Hardware   
[28.03.2023]

Breaking apart electronic waste, upcycling

Introduction to using handtools

**Assignment: Design Challenge Four:** Upcycling Electronic Waste

Week 6: Digital I/O Prototyping Electronics  
[04.04.2023]

**Sign up at https://www.tinkercad.com/ for the Arduino Simulation.**

Getting Our Hands Dirty Programming for Embedded Systems, Breadboarding, Arduino IDE, Digital in/outputs,

Blinking a LED, S.O.S. Task

**Tutorials on Introduction to Arduino:**

1) <https://learn.sparkfun.com/tutorials/sik-experiment-guide-for-the-arduino-101genuino-101-board/all#download-and-setup-the-arduino-software>

2) https://learn.sparkfun.com/tutorials/sik-experiment-guide-for-the-arduino-101genuino-101-board/all#experiment-1-blinking-an-led

3) https://learn.sparkfun.com/tutorials/sik-experiment-guide-for-the-arduino-101genuino-101-board/all#experiment-3-driving-an-rgb-led

**Quiz 4:** Digital I/O Prototyping Electronics

Week 7: Analog Sensors: Photocell/PWM Example, Soldering Tips  
[11.04.2023-online]

Reading Schematic Diagrams, Conductivity, Electricity: The Basics, Basic Electronic Components

**Tutorial Session 02 (Digital Buttons):** Follow the Tutorials on

1) https://learn.sparkfun.com/tutorials/sik-experiment-guide-for-the-arduino-101genuino-101-board/all#experiment-5-reading-a-button-press

**Assignment: Design Challenge Five:** Build a circuitry that lights a random LED each time button is pressed.

*Equipment: 7 x LEDs, Button, 10kOhm Resistor, 7 x 220 Ohm Resistor, Breadboard, Arduino*

[18.04.2023]

NO CLASSES: Semester Break

Week 8: Building your own Standalone Arduino on a Breadboard

[25.04.2023]

Sensors, Analog Input/Output, Analog

**Assignment: Design Challenge Five:** Build a smart circuitry that changes the color of an RGB LED each time tilted up (use: Standalone Arduino breadboard version)

*Equipment: Reed Switch with Mercury Contact, RGB LED, Arduino Components*

Week 9: Accurate Prototyping with 3D Printing

[02.05.2023-online]

**Assignment: Design Challenge Six:** Earthquake Alarm Project

Week 10: Accurate Prototyping with 3D Printing  
[09.05.2023]

**Assignment: Design Challenge Six:** Earthquake Alarm Project

Week 11: Accurate Prototyping with 3D Printing

[16.05.2023] Re

**Assignment: Design Challenge Six:** Earthquake Alarm Project

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Week 12: Final Project  
[23.05.2023] R

Final Project to be introduced

Week 13: Final Project in progress  
[30.05.2023] Reviews

In Class Reviews

Week 14: Final Project Presentations / Submissons   
[06.06.2023]

In Class Presentations