Project Two Worksheets (TEAM)

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MILESTONE ZERO (TEAM): TEAM DEVELOPMENT AND PROJECT PLANNING

PROJECT TWO: MILESTONE 0 – COVER PAGE

Team ID: Thurs-50

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Jennifer Duong	duongj21
Furqaan Khurram Qamar	khurramf
Shadi El-Fares	elfaress
Jessica Ricafort	ricaforj

Insert your Team Portrait in the dialog box below

MILESTONE 0 – SUB-TEAM CHARTER

Team ID: Thurs-50

Indicate which team member is on each sub-team in the table below.

- You may refer to the **P2P3 Overview** document on Avenue for information on each sub-team's requirements

Sub-Team	Team Member's Full Name
Modelling	Furqaan Qamar
	Shadi El-Fares
Computing	Jessica Ricafort
	Jennifer Duong

MILESTONE 0 – TEAM CHARTER

Team ID: Thurs-50

Incoming Personnel Administrative Portfolio:

Prior to identifying Leads, identify each team members incoming experience with various **Project Leads**

	Team Member Name:	Project Leads
1.	Jennifer Duong	☐M ☒A ☐C ☐A2
2.	Furqaan Khurram Qamar	☐M ☐A ☐C ☒A2
3.	Shadi El-Fares	☐M ☐A ☒C ☐A2
4.	Jessica Ricafort	☒M ☐A ☐C ☐A2
		☐M ☐A ☐C ☐A2

To 'check' each box in the Project Leads column, you must have this document open in the Microsoft Word Desktop App (not the browser and not MS Teams)

Project Leads:

Identify team member details (Name and MACID) in the space below.

Role:	Team Member Name:	MacID
Manager	Jessica Ricafort	ricaforj
Administrator 1	Jennifer Duong	duongj21
Administrator 2	Furqaan Khurram Qamar	khurramf
Coordinator	Shadi El-Fares	elfaress

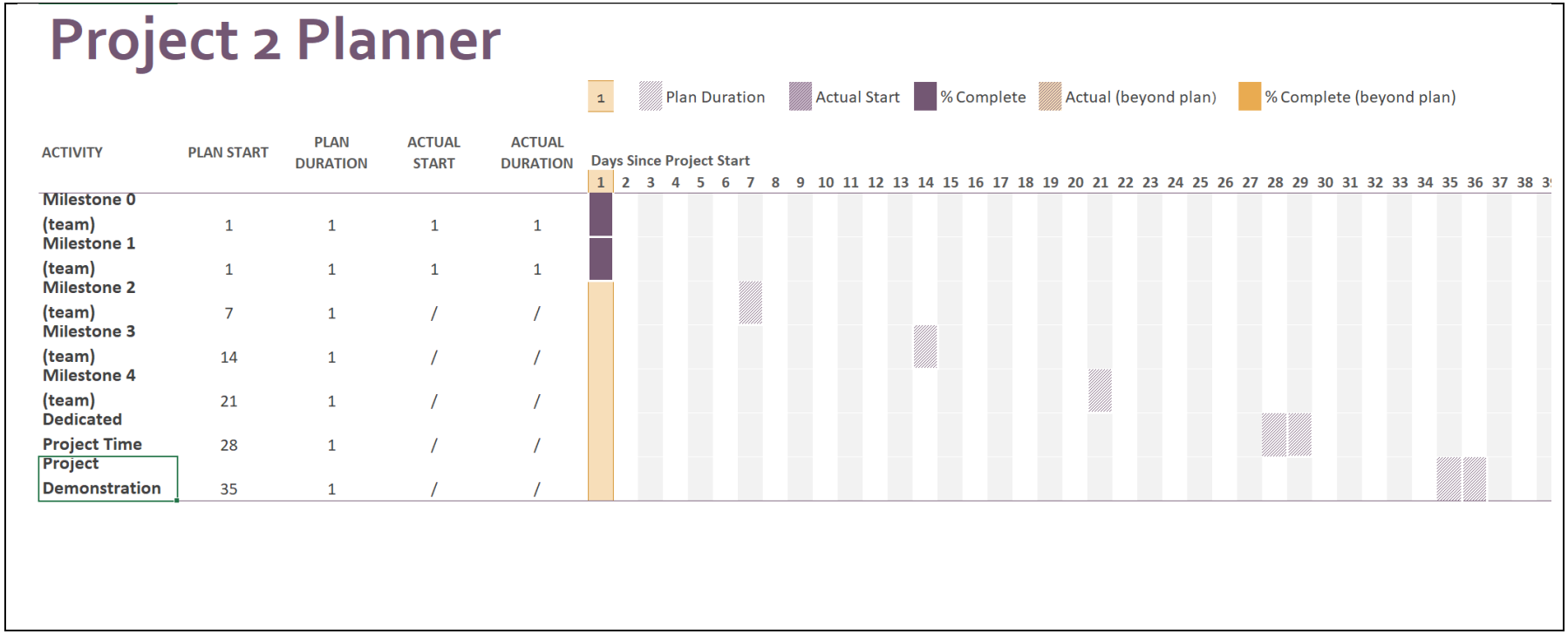
MILESTONE 0 – PRELIMINARY GANTT CHART (TEAM MANAGER ONLY)

Team ID: Thurs-50

Only the **Team Manager** is completing this section!

Full Name of Team Manager:	MacID:
Jessica Ricafort	ricaforj

Preliminary Gantt chart:



MILESTONE ONE (TEAM): OBJECTIVES, MORPH CHART, & INITIAL DESIGN

PROJECT TWO: MILESTONE 1 – COVER PAGE

Team ID: Thurs-50

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Jessica Ricafort	ricaforj
Jennifer Duong	duongj21
Furqaan Khurram Qamar	khurramff
Shadi El-Fares	elfaress

MILESTONE 1 (STAGE 1) – LIST OF OBJECTIVES, CONSTRAINTS, AND FUNCTIONS

Team ID: Thurs-50

1. As a team, create a list of objectives, constraints, and functions in the table below.
   → The exact number you should have depends on what information you have gathered from the Project Module.

Objectives	Constraints	Functions
Safely pick-up box.	Q-Arm should not break/drop the box.	Box allows tool to be sterilized on all surfaces.
Durable	Dimensions of each box to weigh below 350g.	Box securely holds surgical tool.
Efficient	Cannot be slow during transfer.	Able to safely transfer the box to sterilization area
Simple design	Shape of box – can only fit one tool	Maintains organization of tools.
Safety to deliver the tool	Smaller boxes must be smaller or equal or less than 80mm in width and larger boxes must be 150mm or less in width.	Not drop the box through delivery.

2. What is the primary function of the entire system?

To safely transfer unsterile surgical tools within the secure container.

3. What are the secondary functions?

Pick-up the box.
Displace the box.
Gently releasing the box.
Secure box

MILESTONE 1 (STAGE 2) – MORPHOLOGICAL ANALYSIS

Team ID: Thurs-50

1. Identify multiple means to perform the secondary functions that your team came up with during Stage 1 of this milestone. One sub-function (pick up) is already listed for you. The other two sub-functions are for your team to choose.
   → Make sure that every mean for the "pick up" sub-function assumes that the end effector of the robot arm is a gripper. The means for your other sub-functions do not need to follow this assumption.

Function	**Means**					
Pick up	Gripper	Potentiometer	Safety Protocols	Instructions (code)	Gears	Resistors
Secure the Box	Lock system	Fits tightly	Indents to allow for greater friction	Maximize tensile strength		
Gently release		Padding at the bottom of the box	Shape bottom of container to absorb impact		Code to change time of release	Material of container

MILESTONE TWO (TEAM): SUBTEAMS, SKETCHES, & WORKFLOW

PROJECT TWO: MILESTONE 2 – COVER PAGE

Team ID: Thurs-50

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Jessica Ricafort	ricaforj
Jennifer Duong	duongj21
Furqaan Khurram Qamar	khurramff
Shadi El-Fares	elfaress

MILESTONE 2 (STAGE 2) – LOW-FIDELITY PROTOTYPE OBSERVATIONS (MODELLING SUB-TEAM)

Team ID: Thurs-50

As a sub-team, document your observations for each low-fidelity prototype. Make sure to label your observations to indicate which prototype it belongs to. As a starting, consider the following: (note, this does not fully encompass all discussion points)

→ Advantages and disadvantages of each prototype
→ Extent to which each concept aligns (or does not align) with the List of Objectives, Constraints, and Functions you came up with for Milestone 1
→ Reliability of the design in being picked up by the QArm
→ Reliability of the design in securing the surgical tool
→ Extent to which it allows for tool sterilization

*Document your observations for each prototype in the space below. It is recommended you document observations in a **table** or in bullet form (it should be clear which prototype you are referring to for each observation.*	
SHADI'S PROTOTYPE	*Advantages:* - *Durable design* - *Compact size* - *Extremely light* - *Aesthetically pleasing* *Disadvantages:* - *No tensile strength* - *Not enough space for good grip* - *Not spacious for tool itself* - *Unnecessarily **long***
FURQAAN'S PROTOTYPE	*Advantages:* - *Simple design* - *Easy to grip.* - *Secure* - *Spacious to fit a tool.* - *The holes act as a drainage system* - *Holes reduce weight.* *Disadvantages:* - *Too much space, the tool will be loose.* - *Not secure to fit the tools* - *Should be more compact*

	- -

MILESTONE 2 (STAGE 2) – WORKFLOW PEER-REVIEW (COMPUTATION SUB-TEAM)

Team ID: Thurs-50

As a sub-team, document your observations, specifically any similarities and differences between each team member's visual storyboard or flowchart, and pseudocode in the table below.

Document your observations for each visual storyboard / flowchart in the space below.

Similarities	Differences
- Same procedure of flowchart - Actions are the same for each steps - Both have start positions -	- More decisions made in one flowchart than the other - One does not have an end to the flowchart - One flowchart addresses the thresholds while the other doesn't - -

MILESTONE 2 (STAGE 2) – PROGRAM PSEUDOCODE COMPLIATION (COMPUTATION SUB-TEAM)

Team ID: Thurs-50

As a sub-team, write out a pseudocode outlining the high-level workflow of your computer program in the space below. This should be a compilation of the pseudocode completed by each group member in Milestone 1.

Rotate arm to face the container and stay on the same axis.
Open the grip of arm if not already open.
Lower the arm down towards the container until it on the same level as the container.
Close the grip until it is secure around the box.
Rotate the arm back up so that the box leaves the ground.
Roate the arm towards the place to sterilization.
Slowly lower the arm down towards the surface until it is reached.
Gently open the grip of the arm and release the container.
Close the grip of the box.
Rotate the arm away from the sterilization area.

MILESTONE THREE (TEAM): PRELIMINARY MODEL & CODE

PROJECT TWO: MILESTONE 3 – COVER PAGE

Team ID: Thurs-50

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Jessica Ricafort	ricaforj
Jennifer Duong	duongj21
Furqaan Khurram Qamar	khurramff
Shadi El-Fares	elfaress

MILESTONE 3 (STAGE 1) – INITIAL DESIGN OF FINALIZED STERILIZATION CONTAINER (MODELLING SUB-TEAM)

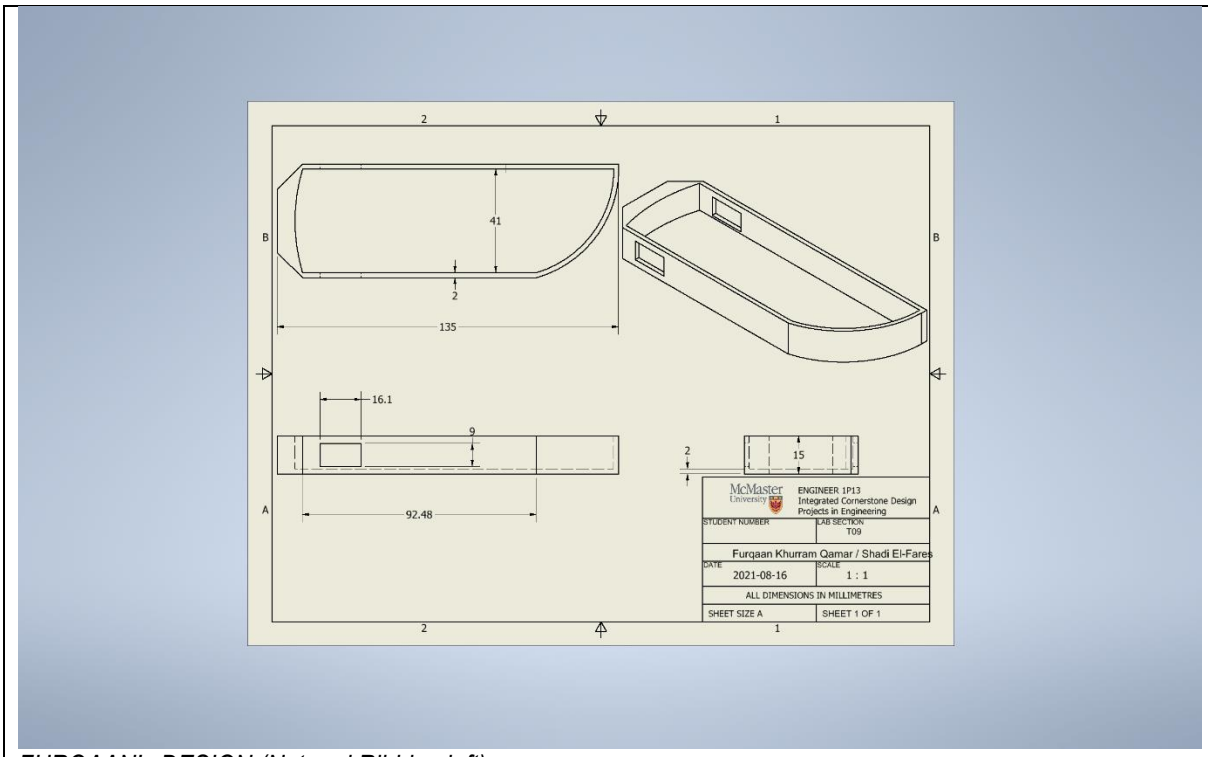
Team ID: Thurs-50

As a team, review each others preliminary solid models and discuss which features from each others models align best with the project objectives, constraints and functions. Summarize this in the table below.

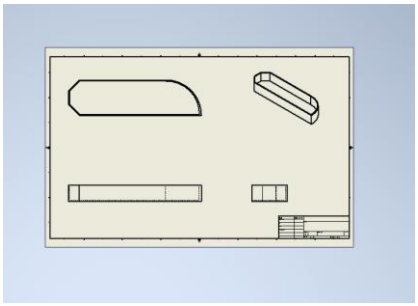
Container	Feature	How it aligns with project objectives, constraints and functions.
Bone-Saw	Snug Fit	Ensures safe travel of surgical equipment and reduces overall weight amount.
Bone-Saw	Curved Bezel	Ensures the bone-saw remains sharp and in-line with the container shape.
Bone-Saw	Gripper Placeholders	Allows for a safe and secure grasp of the container for the Q-arm to grip.

Create a preliminary sketch of your finalized sterilization container. This sketch should consider features from both team-members preliminary solid models.

Name (Team Member #1): **Shadi El-Fares**	**Name (Team Member #2):** **FurqaanKhurram Qamar**
Insert an image of your sketch here.	



FURQAAN's DESIGN (Net and Ribbing left)



Shadi's Design

MILESTONE 3 (STAGE 1) – PROGRAM TASK PSEUDOCODE (COMPUTATION SUB-TEAM)

Team ID: Thurs-50

As a team, write out the pseudocode for each of the *remaining* tasks in your computer program in the space below.

Pick-up Container

- Input the container number and identity (size and colour)
- If the container identity is equal to green, the q-bot arm moves to the green box's position
    - If the container number is 2, the q-bot arm moves to the top of the green box
    - If the container number is 5, the q-bot arm moves to the open drawer
- If the container identity is equal to red, the q-bot arm moves to the red box's position
    - If the container number is 1, the q-bot arm moves to the top of the green box
    - If the container number is 4, the q-bot arm moves to the open drawer
- If the container identity is equal to blue, the q-bot arm moves to the blue box's position
    - If the container number is 3, the q-bot arm moves to the top of the green box
    - If the container number is 6, the q-bot arm moves to the open drawer

Continue or Terminate Program

- Program will ask for container colour
- Program will ask for container identity
- If the container identity of the last input is equal to the newest container identity input, then the program does not continue, and asks to enter a different value of the identity instead

MILESTONE 3 (STAGE 2) – STERILIZATION CONTAINER DESIGN EVALUATION (MODELING SUB-TEAM)

Team ID: Thurs-50

1. As a team, evaluate your designs for the sterilization container in the table below
   → List your Criteria in the first column
      - You should include a minimum of 5 criteria
   → Fill out the table below, comparing your designs against the given baseline
      - Replace "Design A" and "Design B" with more descriptive labels (e.g., a distinguishing feature or the name of the student author)
      - Assign the datum as the baseline for comparison
      - Indicate a "+" if a concept is better than the baseline, a "–" if a concept is worse, or a "S" if a concept is the same

	Datum	Netted + Ribbed Gripper Hole Design	Solid, Non Netted	**Finalized Design**
Sterilization	S	+	-	+
Ability to Grib	S	+	-	+
size	S	S	S	S
Rigidity	S	-	+	S
Complexity (Less				

complexity means good)	S	-	S	-
Equipment Security	S	+	+	+
Total +	0	3	2	3
Total –	0	2	2	1
Total	0	1	0	2

*For a team of 3, click the top-right corner of the table to "Add a New Column"

2. Propose one or more suggested design refinements moving forward

(Shadi's Design) Non-Netted, Solid Design

- It needs a better method of securing the equipment.
- The container needs to be thicker; it currently has a thickness of 1mm which is enough to perform its primary task and allows more free space for the equipment, but low thickness will be a disadvantage as the arm's end effector might exert too much force and crush the container.

Furqaan's design

- Design and make tools holders to make sure they don't drop, slide etc.
- Add netted design for sterilization.
- Add extra supports near edges for strength

MILESTONE 3 (STAGE 2) – CODE PEER-REVIEW (COMPUTATION SUB-TEAM)

Team ID: Thurs-50

Document any errors and/or observations for each team member's preliminary Python program in the space below

Rotate Q-arm Base	**Team Member Name**: Jennifer Duong

Preliminary code:

```
# Declare variables

initialPosition= arm.effector_position() # Find the coordinates of initial positoin of Q-arm


x1= initialPosition[0]
y1= initialPosition[1]
z1= initialPosition[2]

box1Position= box1.effector_position() # Find the position of the first box
x2= initialPosition[0]
y2= initialPosition[1]
z2= initialPosition[2]


# Rotate towards the green container

while(x1!= x2):             # Rotate arm until the x coordinates align
    arm.rotate_base(1)

while(y1!= y2):             # Rotate arm until the y coordinates align
    arm.rotate_base(1)

while(z1!= z2):             # Rotate arm until the z coordinates align
    arm.rotate_base(1)
```

Errors:

- No code which activates the potentiometer
- Does not have any way of accessing the initial positions of the containers
- There is no specified angle to rotate the arm base
- Does not run whatsoever with the q-arm

Drop-off Container & Return Home	**Team Member Name**: Jessica Ricafort

Preliminary code:

File Edit Format Run Options Window Help

```
ip_address = 'localhost' # Enter your IP Address here
project_identifier = 'P2B' # Enter the project identifier i.e. P2A or P2B
#-----------------------------------------------------------------------------
import sys
sys.path.append('../')
from Common.simulation_project_library import *

hardware = False
QLabs = configure_environment(project_identifier, ip_address, hardware).QLabs
arm = qarm(project_identifier,ip_address,QLabs,hardware)
potentiometer = potentiometer_interface()
#-----------------------------------------------------------------------------
# STUDENT CODE BEGINS
#-----------------------------------------------------------------------------

potentiometer.right()
0.4
potentiometer.left()
0.7
arm.activate_autoclaves()
arm.check_autoclaves('red')
arm.open_autoclaves('red')
arm.control_gripper(45)
arm.open_autoclaves('red',false)
arm.deactivate_autoclaves()
arm.home()
```

Errors:

- The potentiometer code will not work because there was no code that would activate the potentiometers
- There is no code that opens the gripper to actually drop off the container
- The activate autoclave line should be the first line of the code
- The deactivate autoclave line should be the last line of the code

MILESTONE 3 (STAGE 3) – PRELIMINARY DESIGN REVIEWS

Team ID: Thurs-50

Preliminary Design Review Planning:

Create an outline of topics you will cover during your preliminary design review. You should cover the following topics:

1. Both sub-teams:
    a. Integration of both sub-teams for the final deliverables
    b. Timeline for project completion
2. Modelling sub-team:
    a. Demonstrate your most recent prototype
    b. How your current sterilization container meets project objectives.
    c. Plan for fabrication
3. Computing sub-team:
    a. Demonstrate your current program.
    b. Updates on the workflow implementation (i.e. how much of the workflow has been implemented)
    c. Process of integrating both group member's code.

Timeline:
Coding – 2 weeks
Graphics – 1 week

Graphics Team:

- **November 10: Adding Meshed Design and Ribs**
- **November 11: Finalize Container and Generate G-Code**

Coding Team:

- **November 15: Finish writing all the functions for the Q-Arm code and be able to demo picking up one of the containers**

Modelling Sub-Team Preliminary Design Review Notes:

Use the space below to document feedback for your design.

The feedback we reeived revolved around the following points:

Make sure it is within weight limit.

Securing Blade within Design

Discuss about how gas will go through container

Minimum constraint per feature of 2mm

Use the space below to propose further design refinements based on the feedback.

-Meshed Design

-Support Ribs at Corners

Computing Sub-Team Preliminary Design Review Notes:

Use the space below to document feedback for your design.

- Do not have to identify different pick up locations, all of the boxes spawn in the same location
- Activating the autoclaves should be the first line of code
- Opening the autoclave drawer can be run while the q arm is holding the containers
-
- Create your functions in the python file and run the code in the IDLE
- Figure out an algorithm as to how the container will be picked up and dropped off

Use the space below to propose further design refinements based on the feedback.

- Have functions for each step of the movement
- Have functions that determine the size and colour of the container
- Create an algorithm for the general flow of the container pick up/drop off

MILESTONE FOUR: DETAIL DESIGN (DESIGN REVIEW AND FEEDBACK)

PROJECT TWO: MILESTONE 4 – COVER PAGE

Team ID: Thurs-50

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Jessica Ricafort	ricaforj
Jennifer Duong	duongj21
Furqaan Khurram Qamar	khurramff
Shadi El-Fares	elfaress

MILESTONE 4 CHECKLISTS

Mentors and sub-teams will go through each checklist **together** and check off items if the design meets expectations. Mentors will give verbal feedback for each item on the checklists, and students will **summarize the feedback** before creating a list of **Action Items** to be completed before final project submission. *Note that these checklists are not project rubrics. They are a tool to help guide students to successfully meet certain project requirements.*

Team ID: Thurs-50

MODELLING SUB-TEAM

☑ Design Meets Design Objectives

- → Container fits inside the assigned footprint
- → Surgical tools fit securely inside the container
- → Container facilitates sterilization
- → Design is creative with interesting features and/or connections

☑ Assembly model is complete and aesthetic, properly grounded and has no interference or errors

☐ Mass constraint is satisfied (does not exceed 350 g prior to scaling or 43.75 g after scaling to 50%)

- → The design should intentionally minimize materials

☐ Total print time of **ALL** components does not exceed 2 hours

- → All components on the bed when evaluating this
- → Discuss if components need any support for 3D printing (i.e., for any overhanging features). If so, TA's will assist the sub-team in adding support.

☑ ALL features of container are 2mm or more

- → Not only do features need to be 2mm or greater, but spaces between them as well
- → Features between 2mm and 4mm are appropriately sized and will not compromise the printed design

☑ **APPROVED FOR PRINTING**

Mentor Comments: Use the space below to document mentor feedback for your design, including requirement for reviewing progress next design studio.

N/A

Action Items: Use the space below to propose design refinements based on feedback.

N/A

COMPUTATION SUB-TEAM

Team ID: Thurs-50

- [x] One cycle of pick-up/rotate/drop-off (one container of any size) sufficiently executes
  - → The general flow should be home → pick-up → rotate → drop-off → home
  - → Containers dropped in random order, program identifies the correct drop off location and places the container successfully
  - → *If* there is time, demo both a small and a large container, and experiment using the potentiometers incorrectly to test for malfunctions
- [x] All required program tasks are written as their own function (Pick-Up Container, Rotate Q-arm Base , Drop-Off Container & Return Home)
- [ ] All program tasks are accounted for (Pick-Up Container, Rotate Q-arm Base , Drop-Off Container & Return Home, Continue or Terminate Program)
- [ ] Each task requiring potentiometer input (Rotate Q-arm Base , Drop-Off Container & Return Home) evaluates the potentiometer values before executing an action
  - → Potentiometer values are evaluated *INSIDE* the functions and not outside and passing their values as arguments.
- [x] Team is running their program in their assigned environment.
- [x] No errors in program
- [x] Code well commented

Mentor Comments: Use the space below to document mentor feedback for your design, including requirement for reviewing progress next design studio.

- Use potentiometer to rotate the base and to move the arm to the upper or lower drop off positions
- User can not input the box number to be generated, it has to be drawn from a list and the number has to delete after it was used

Action Items:

- Watch the p2 video about how to implement the potentiometer into the code
- Change the rotate base and drop off function to work with the potentiometer
- Make a function to randomly generate a box which corresponds to its destination place (delete the container that has already been dropped off)