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

MILESTONE 1 (STAGE 1) – PRE-PROJECT ASSIGNMENT

Team ID: Thurs-04

Complete this worksheet individually before coming to Design Studio 7.

1. List out objectives, constraints, and functions in the space below
   → Be sure include your Name and MacID
   → Each objective/constraint/function should be typed out as a separate bullet

Name: Andrew Habib	MacID: habiba21

Objectives

- Lightweight
- Cost-efficient
- Fast execution in picking up / transfer of container

Constraints

- *Maximum/Minimum Size based on Autoclave*
- *Min Temperature withstand*
- *Minimum dimension of 2 mm*

Functions

- Design must be able to pick up a container
- Design must be able to transfer a container to correct Autoclave bin
- Hold surgical tools securely
- Withstand sterilization conditions such as steam

MILESTONE 2 (STAGE 2) – COMPUTER PROGRAM WORKFLOW (COMPUTATION SUB-TEAM)

Team ID: Thurs-04

Complete this worksheet individually before coming to Design Studio 8.

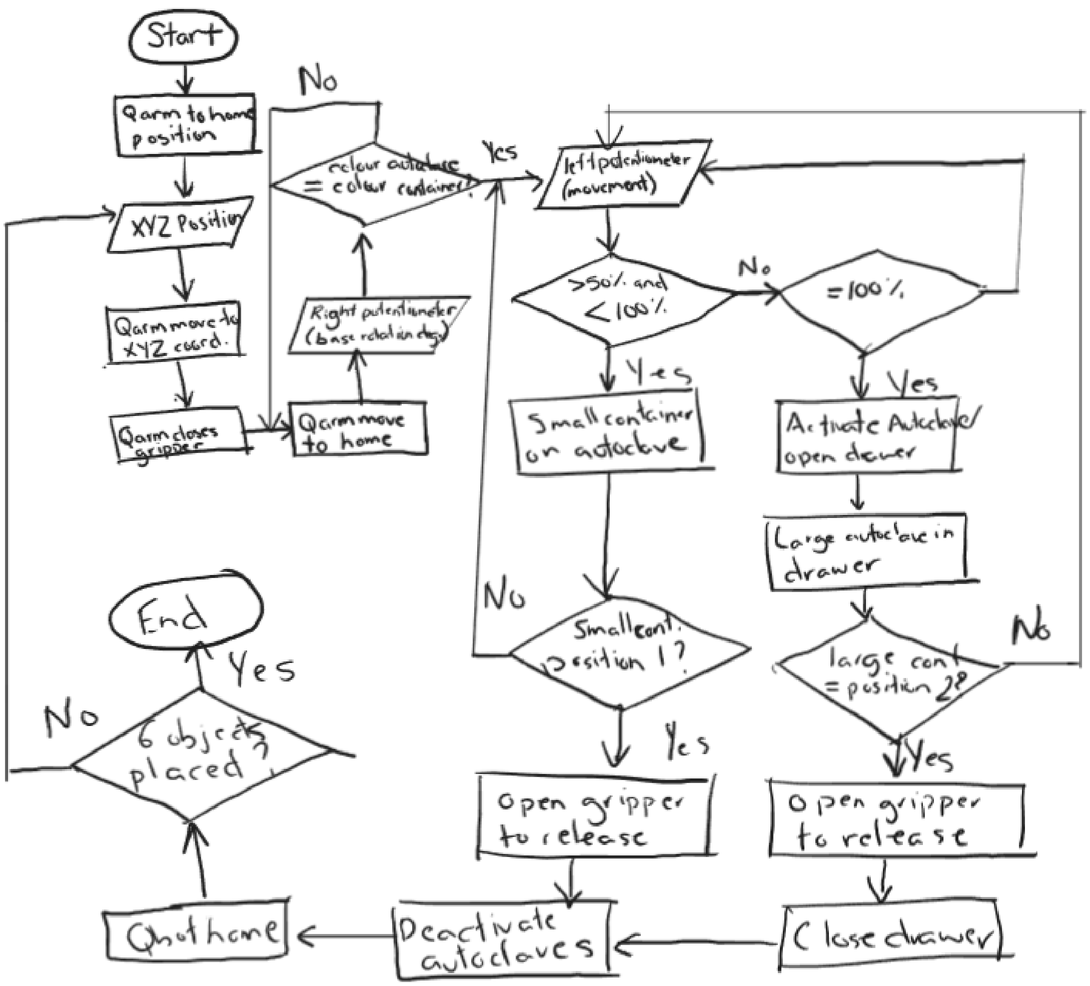
1. Complete your storyboard or flowchart sketches on a separate sheet of paper
   → Be sure to clearly write your Team ID, Name and MacID on *each* workflow
2. Take a photo of your sketch
3. Insert your photo as a Picture (Insert > Picture > This Device)

Team ID: Thurs-04

Name: Andrew Habib	MacID: habiba21

Insert screenshot(s) of your workflow below

P2 Flowchart Milestone 1



MILESTONE 3 (STAGE 2) – PRELIMINARY PROGRAM TASKS (COMPUTATION SUB-TEAM)

Team ID: Thurs-04

Complete this worksheet individually before coming to Design Studio 9.

1. Take multiple screenshots of your code
   → You are also required to submit a Python (*.PY) file of your code (see Submission Details section above)
   → Be sure to label your tasks with your Name and MacID
2. Insert your photo(s) as a Picture (Insert > Picture > This Device)
3. **Do not include more than *one* screenshot per page**

Team ID: Thurs-04

Name: Andrew Habib	MacID habiba21
Insert screenshot(s) of your code below	

*Limit screenshots to no more than 1 per page. For additional screenshots, please copy and paste the above on a new page

Rotate Qarm Bases

Old individual

```
def rotate_qarm_base(colour):
    old_potentiometer_reading = potentiomter.right()
    new_potentiometer_reading = potentiometer.right()
    while arm.check_autclaves(colour) == False:
        old_potentiometer_reading = new_potentiometer_reading
        new_potentiometer_reading = potentiomter.right()
        degree_motion = new_potentiometer_reading - old_potentiometer_reading
        arm.rotate_base(degree_motion)

rotate_qarm_base()
```

New Updated

```
def rotate_qarm_base():
    old_potentiometer_reading = potentiometer.right() * 100 * 3.2
    new_potentiometer_reading = potentiometer.right() * 100 * 3.2
    while arm.check_autoclave('green') == False:
        old_potentiometer_reading = new_potentiometer_reading
        new_potentiometer_reading = potentiometer.right() * 100 * 3.2
        degree_motion = new_potentiometer_reading - old_potentiometer_reading
        arm.rotate_base(degree_motion)
rotate_qarm_base()
```

INDEPENDENT MATERIALS RESEARCH ASSIGNMENT

MATERIAL SELECTION (STAGE 1): PROBLEM DEFINITION

Use the following information to help you in your assignment:

- Function: The containers must securely contain a surgical tool during the tool's sterilization period.
- Fixed Variable: Radius, melting temperature (100^{O}C, steam)
- Free Variable: Wall thickness
- Objective: Must minimize cost and mass (material density and CAD)

Use the following MPI's to select your final material:

- Stiffness Design: $\frac{E}{\rho C_m}$
- Strength Design: $\frac{\sigma}{\rho C_m}$

Chosen Design	Chosen MPI	Objective
Stiffness Design	$\frac{E}{\rho C_m}$	Minimize cost and mass

Please provide a short justification for your chosen design and MPI.

Stiffness should be prioritized in this design because the container is required to securely hold the tools during the sterilization period while withstanding the pressure and heat conditions present within the autoclave. While strength attempts to avoid breaking in the material, high stiffness allows it to revert to its original state following forces acting on it.[1] Keeping this in mind, stiffness is important in ensuring that the container's structural integrity is maintained while facing extreme thermal and pressure conditions causing molecular changes that must be reverted. [1] In this case, breaking is unlikely to happen within the autoclave, but it is possible that great amounts of heat and pressure will cause severe molecular altercations which can be reduced with a correct MPI for stiffness.

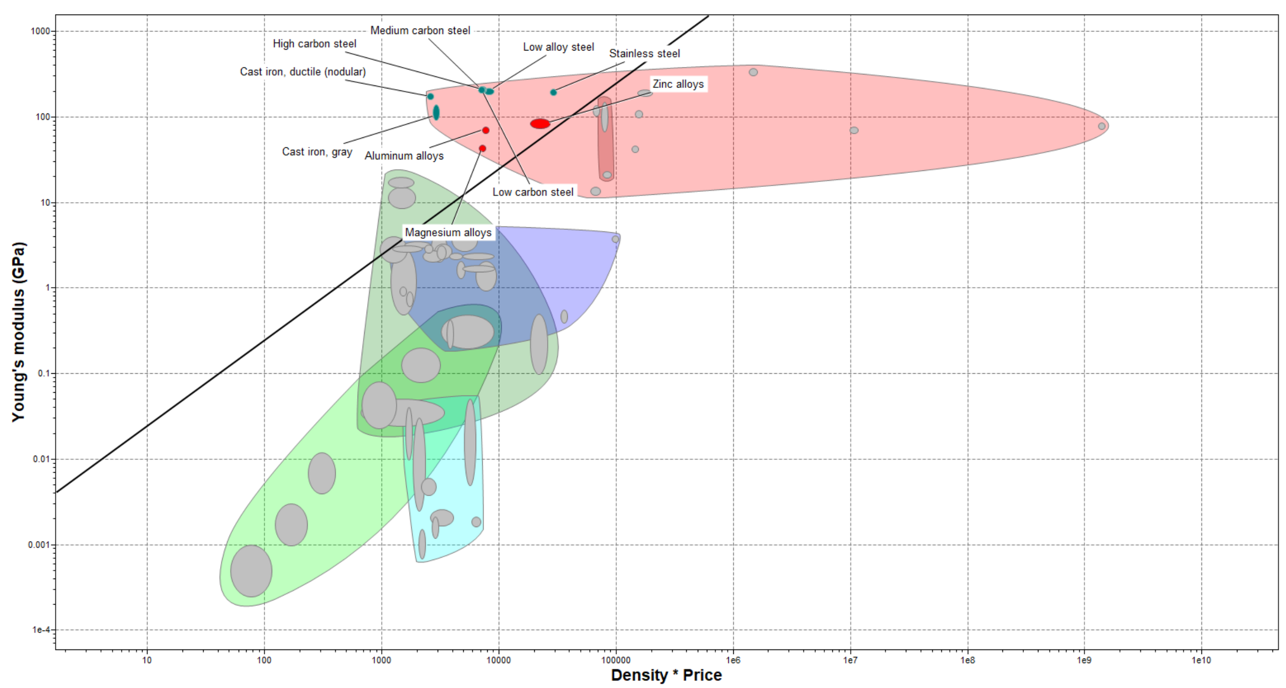
References:

[1] "Stiffness vs. strength: Differences and key factors to note," rapiddirect, 02-Aug-2022. [Online]. Available: https://www.rapiddirect.com/blog/stiffness-of-material/. [Accessed: 27-Nov-2022].

MATERIAL SELECTION (STAGE 2): MPI AND MATERIAL RANKING

Include a screenshot of your GRANTA graph in the text box below. The following should be included and visible in your graph:

- X and Y axis
- MPI slope
- Material titles
    - The materials that you may choose from are those that can be 3D-printed (i.e., materials such as ceramics and glasses should be excluded from your database)
- Material family bubbles



Material Ranking			
	Rank 1	Rank 2	Rank 3
Assigned MPI:	Cast Iron (ductile modular, gray)	Steel (Medium carbon, low carbon, High Carbon, Low alloy, Stainless)	Alloys (Aluminum, Magnesium, Zinc)

MATERIAL SELECTION (STAGE 3): FINAL SELECTION

State your chosen material and justify your final selection

Chosen Material:	Medium Carbon Steel

Discuss and justify your final selection in the space below (based on the MPI results and any other relevant considerations).

Overall, when considering different properties, Medium Carbon Steel proves to be the optimal choice for an autoclave container. With respect to stiffness, Medium Carbon Steel attains one of the highest index values due to its Young's Modulus of 200 GPa (stiffness).[1] While Cast Irons may be cheaper and have the highest index value, they are not 3D printable. Additionally, it fulfills the conditions of the constraint on the melting temperature of 100 degrees Celsius by a significant margin (1420 degrees). This allows it to easily withstand the extreme heat and pressure conditions in the autoclave. [1] Finally, medium carbon steel is ductile enough to be shaped into a cylindrical shape while maintaining some strength. [2] Decisively, medium carbon steel possesses properties that allow it to maintain its molecular structure under extreme conditions of the autoclave while also being a relatively cheap material to buy at 0.887 CAD/kg.

References (If any):

[1] GRANTA Edupack, Ansys GRANTA EduPack software. [DRIVE-C]. Canonsburg, PA. ANSYS, Inc., 2022. "How do wind turbines work?," Energy.gov. [Online]. Available: https://www.energy.gov/eere/wind/how-do-wind-turbines-work. [Accessed: 21-Sep-2022].

[2] "Medium-Carbon Steel," Nuclear Power, 16-Aug-2022. [Online]. Available: https://www.nuclear-power.com/nuclear-engineering/metals-what-are-metals/steels-properties-of-steels/medium-carbon-steel/. [Accessed: 27-Nov-2022].