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

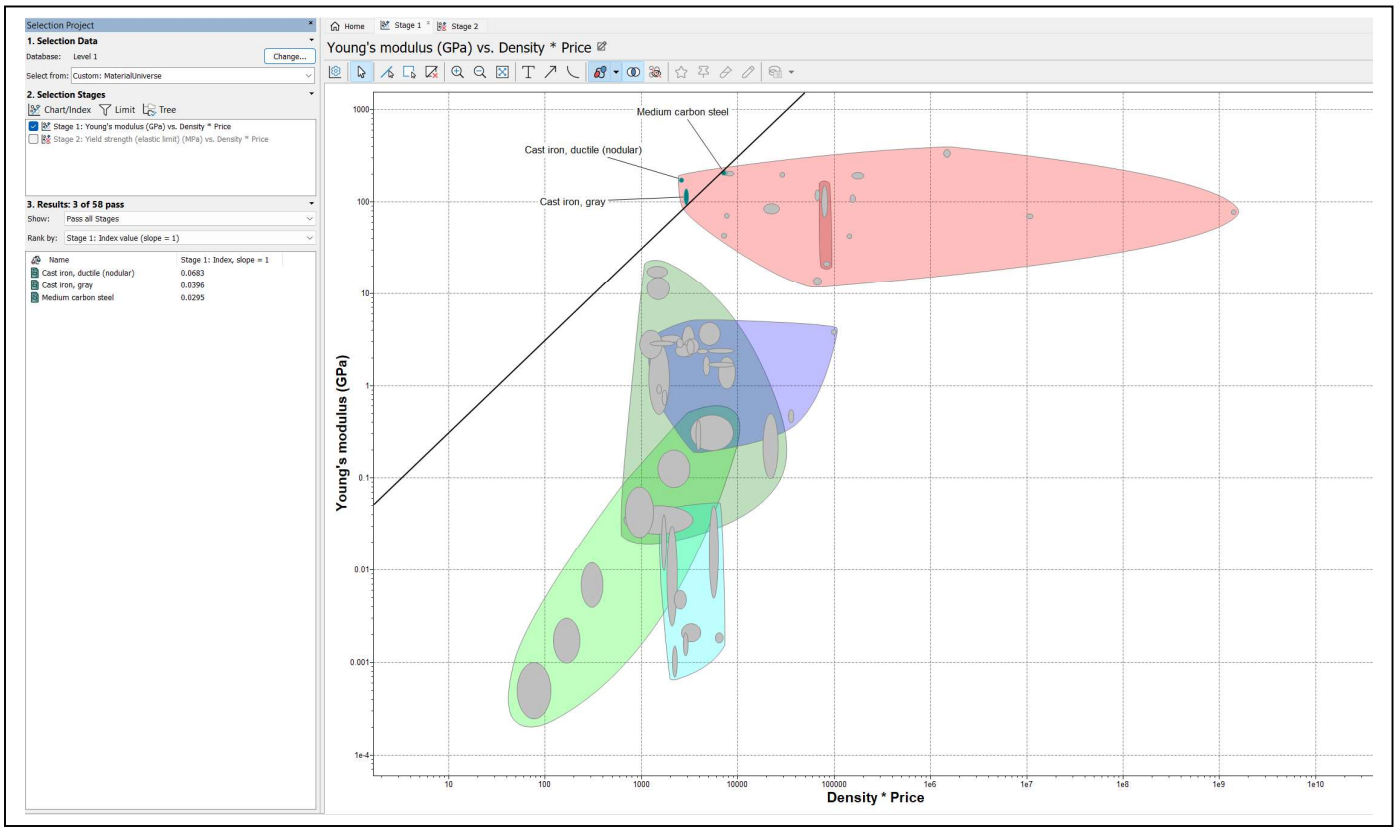
Please provide a short justification for your chosen design and MPI.

Stiffness is the ability to resist external forces causing it to bend. A stiffness design was chosen as the sterilization containers experience considerable force from the Q-Arm grippers, along with pressure from the steam during sterilization. The container walls need to be stiff in order to resist these forces and prevent it from being deformed or collapsing in on itself.

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 clearly visible in your graph:

- X and Y axis
- MPI slope
- Material titles
    - The materials that you may choose from are those that are able to 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: $\frac{E}{\rho C_m}$	Cast iron, ductile (nodular)	Cast iron, gray	Medium carbon steel

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).

The final material selection for a sterilization container is medium carbon steel. Although it was only rank 3 based on the MPI results, after analyzing various material properties, I concluded that it is a better option than the cast irons. Medium carbon steel has a very high melting point between 1.42e3-1.51e3 ˚C, which is well above the 100 ˚C temperature of the steam [1]. Since I am also going for a stiffness design, I must consider the Young's modulus of the materials. Medium carbon steel has the highest Young's modulus between 200-220, whereas the cast irons range from 94-180 [1]. Cast irons are also listed as ductile and malleable, which is not suitable for a container that experiences strenuous force from the Q-arm grippers [1]. Thus, medium carbon steel is the best option for a sterilization container for our scenario.

References (If any):

[1] Ansys Granta EduPack software, ANSYS, Inc., Cambridge, UK, 2022 (www.ansys.com/materials).