



Ontario Engineering Competition 2023

Junior Design Competition Package

OEC 2023

1 Background

Welcome to the 44th Ontario Engineering Competition (OEC) and thank you for choosing to participate! OEC 2023 aims to provide students with an opportunity to apply in-class knowledge and acquire skills for real-world problems. It is an opportunity to challenge oneself, meet like-minded peers, and network with industry professionals. Winners of each category in OEC 2023 will be invited to compete in this year's Canadian Engineering Competition (CEC). We hope you enjoy OEC 2023!

1.1 Competition Logistics

The goal of this Junior Design Competition is to encourage junior undergraduate engineering students to produce a feasible design despite limited materials and preparation time. Engineers are often required to think quickly to produce a working solution given limited resources. In this competition, you will combine teamwork and problem-solving skills to design, construct, test, and present a previously undisclosed project.

The competition will take place over two days. On day 1, you will research, design, and construct a functional prototype for your design; on day 2, you will present and demonstrate your design to a panel of judges. A detailed competition schedule can be found in the following section 1.3.

1.2 Competition Assistant

Facilities Required

Ellen, Tina, and a few enthusiastic volunteers will be providing generous help throughout the competition. We will also be monitoring the question channel on Discord throughout the competition. If you have any questions, just let us know!

OEC Discord Server: <https://discord.gg/CDZQbgsT>

Ellen: etao2@uwo.ca

Tina: txu333@uwo.ca



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1.3 Competition Schedule

Day 1

Time	Event	Platform
4:30 PM - 5:30 PM	Opening Ceremony	HSB 40
5:30 PM	Competition Briefing	Google Classroom
5:45 PM - 6:15 PM	Competition Briefing	ACEB 1410
6:15 PM - 6:30 AM	Question Period	
6:15 PM - 11:45 PM	Competition Period	
11:45 PM	CAD model submission deadline. Prototype and Presentation slides submission deadline	Google Classroom
11:45 PM	Go home!	

Day 2 & 3

Time	Event	Location
8:00 AM	Presentation & Demo Schedule Released	Google Classroom/Discord
8:00 AM - 9:20 AM	Testing/Demo	ACEB 2437 / ACEB 2439
9:20 AM - 9:45 AM	Break	
9:45 AM - 1:00 PM	Presentation	ACEB 2435
1:00 - 2:00 PM	Lunch	
2:00 PM - 3:35 PM	Top Team Presentation	TBD
3:35 PM	Competition Ends!	
7:00 PM - 9:30 PM	Closing Ceremony	Hilton DoubleTree Hotel
DAY 3: 7:30 - 11:00 AM	Breakfast @Hotel/Checkout	Hilton DoubleTree Hotel

2 Introduction

Engineering is a team sport. Behind every project is a group of people coming together to invent, innovate, and design. While the end product could be something original, new ideas are often based on pre-existing work. For OEC 2023, we ask that you push away your preconceived assumptions and start fresh by being open to new beginnings!

Your task will be to build a robotic arm, but unlike the plethora of hydraulic arms you see online, we want you to be creative and combine different types of systems into creating a robotic arm that sorts items.

Teams in Junior Team Design are required to design, construct, and test their project during the limited time provided in the first half of the competition and then present an oral presentation and demonstrate their design in the second half of the competition. The oral presentation



should summarize the design process, the design itself, and any unique aspects of the design to the judges and the general public. Teams must demonstrate the design to show how well it meets the requirements of the project during the allotted testing period.

3 The Challenge

3.1 Challenge Background

Robotic arms have been an industry standard for decades, perfected by engineers to integrate with various manufacturing processes. They have been a very useful design, being able to operate with controlled dexterity in the horizontal and vertical direction as well as through the arms of the machine allows this arm to be ideal for many different kinds of uses. These arm parts are manipulated through a combination of opposing forces being applied for changing directions.

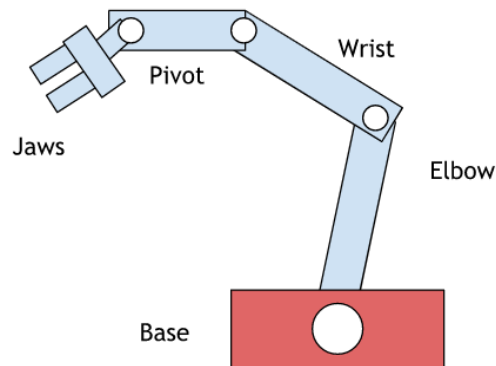


Figure 1. A Simple Movable Arm Example

3.2 Challenge Description

In this challenge, we ask that your team design a robotic arm that can be controlled through a combination of at least 4 different systems. The input will be the user's manipulation, and the output will be an arm that is able to move in multiple joint locations to move and sort items. The arm must be able to move in a minimum of 5 joints locations (jaws, pivot, wrist, elbow, base) as seen in Figure 1.

3.3 Design Objectives

- Arm is able to lift and move items up to **400g** to specified locations
- The arm must be suitable to move in **five** joint locations: jaws should open and close, pivot, wrist, and elbow should all be able to move vertically, and the base should be able to rotate horizontally 360 degrees

Note: Your physical prototype will be tested on output accuracy in the demonstration/testing section.

3.4 Design Criteria and Constraints



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- The arm must be able to pick up and move items within a **30 cm vertical range and 20 cm horizontal range** from ground level
 - Arm must be able to rotate a minimum of **360 degrees**
 - The base width must be **at least 25 cm**, with a tolerance of 10 cm (25 ± 10 cm)
 - Minimum **4 distinct and different systems** must be used to operate the arm movements
 - It is allowed for the teams to repeat ONE of the systems for a total of 5 arm movements
- Note: See penalties for possible deductions if the above-mentioned requirements are not met.*

3.5 Additional Prototype Constraints

- The arm should be operated without the arm components needing to be adjusted by the user, all movement should be through operating the external systems
- A list of parts available for purchase and their prices are provided at the end of this document
- Only one competitor can be in contact with the machine at a time during demonstration
- The device which is able to move all the specified items during the demonstration, at the cheapest build cost, will be considered the baseline for budget efficiency scoring
- While carrying a load, the base of the arm must be in contact with the ground at all times
- Must finish the prototype within the **5-hour design period**, modifications to the prototype after the design period will result in serious penalty
 - The prototype must remain in the building room after the design period.
- The use of the internet is allowed during the design period
- The machine must be able to lift and sort **5 items** during the final testing demonstration
 - Half-filled plastic water bottle (less than or equal to 400g)
 - Empty soda can
 - Spherical ball placed atop a stopper
 - Jenga Block (1.5 cm × 2.5 cm × 7.5 cm)
 - Mystery Item given during final testing period

4 Question Period

The competition briefing will be followed by a Question Period.

- Question Period will have a **15-minute duration**. During this time, competitors can ask the Competition Lead to clarify any point of the Problem Statement, competition rules or competition logistics
- Only the Competition Leads may answer questions
- Questions and answers will be recorded and distributed to the competitors and judges
- The timekeeper will stop the clock if the judges ask a question and resume keeping time when the Category Official has answered the question
- Answers will not be given to any question that might lead to the development of a new approach or that might invalidate a potential solution
- Questions can be submitted via **Discord**. Answers will be distributed via discord to all teams
 - It is your responsibility to monitor the forum for all questions and answers arising



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- Questions will not be accepted during the final 30 minutes of the build session. Questions and responses from the competition will be provided to the judges prior to the presentations and report reviews
- Announcements of the remaining time will be made at 1 hour, 30 minutes, and 10 minutes before the end of the allotted time of the build session

5 Development of the Solution and Preparation of Deliverables

5.1 Time Restrictions

The teams will have **five (5) hours** to develop their solution and prepare their presentation for the judges. All the deliverables must be submitted to **Google Classroom** before the allotted time expires. Competitors may finish before the end of the allotted time without penalty.

5.2 Plagiarism

Work presented by the teams must be their own work. The teams may use and cite previously published work with proper referencing. Violations will be ruled on by the Category Official and may be grounds for disqualification.

5.3 Submission Protocol

The final presentation is to be submitted electronically via Google Classroom with the naming convention “[**Team Name**].zip” along with your prototype. It must be submitted to the Competition Lead any time before the expiry of the five (5) hours. You must stop working on all the project components (presentation, prototype) after 5 hours. Late deliveries will not be accepted.

6 Testing Rules

- The teams will have access to a spreadsheet where they can sign up for testing their prototypes
- Each team may only have one **10-minute** reservation at any time and must use up the testing period before reserving the next one. Teams may only reserve whichever time slot is available next (i.e. teams may not specify a time)
- Teams are allowed to make cancellations to reservations. A canceled time slot then becomes the next available testing period and can be reserved by whichever team makes the reservation next. Time slots after the cancellation will not be bumped forward
- A volunteer will come to your room with the testing materials

7 Final Presentation

- The presentation order will be determined randomly and will be announced at **7 am** on Saturday to all competitors via Discord and/or Google Classroom
- Each team is allowed **15 minutes** to present their solution
- A **five (5) minute question period** will follow each presentation during which judges and the general public will be allowed to ask questions, with priority given to the judges’ questions
- During demonstration time, the team may showcase their functioning prototype



- Judges may ask brief questions during the presentation for clarification but should hold detailed questions until the question period. Time will be halted while a judge asks a question and while the team responds
- The remaining time must be indicated at 5 minutes and 1 minute before the end of the allotted time

8 Final Testing

Teams will have 10 minutes to demonstrate their working prototype. Once the team has indicated to the timekeeper that they are ready to begin, the timekeeper will provide a countdown from 3, following the cadence of 3, 2, 1, go. Once the time has begun, teams will not be able to restart their demonstration.

The testing should demonstrate the following:

1. 360° overview of the prototype:
 - a. Show that the robotic arm is able to have a vertical range of motion of 30 cm from ground level and 20 cm horizontal range
 - b. Show that the base width must be at least 25 cm with a tolerance of 10 cm (25 ± 10 cm)
 - c. Show that the base of the arm can rotate 360 degrees horizontally
 - d. Demonstrate the 5 total systems for operating the arm movements (4 systems must be distinct and different from each other)
2. Present the robotic arm moving and sorting 5 different items
 - a. Sort the given items into certain specified positions on the table
 - i. Locations of the items will be unknown until the presentation phase
 - ii. The locations of the items will be different for the final testing period than the general testing station throughout the build
 - iii. There will be 5 items total, 4 given during the prototyping design process and the 5th will be of an unknown height, weight and size
3. You have 3 “lifelines” in case any items are knocked over or fall off the table meaning you may interact with the items to be moved

9 Shop Rules

- A maximum of one (1) person per team may be in the shop at any time
- Building materials will be available for preview at the shop. Competitors may examine the materials but are not allowed to leave the display table with unpaid materials.
- Teams are allowed to take pictures of building materials
- Teams must purchase the number of items that they request. If a requested quantity is not available, the team may request a new quantity
- Teams must keep track of their purchases for their own records. The shop will keep track of the official purchase records. In the event that a team has lost track of their purchases, the team will not be told how much they have spent
- All sales are **final**. Be sure to verify purchased items and quantities before leaving the shop
- Teams may not trade building materials. Violation of this rule may result in disqualification for both teams



- Please be courteous and professional to shop personnel. The shop reserves the right to refuse service to an individual who behaves unprofessionally
- The shop will close 30 minutes before the end of the build period

10 Scoring

Rubric

Team #:		
Criteria		Score
Design performance	Number of masses moved (25) Linear weighting from cheapest to most expensive functional design. The cheapest is awarded 10, and the most expensive 0. Penalties: Not including 4 distinct and different systems (-25 each) Non-permitted materials used in prototype (-50) Prototype does not fit all design measurement constraints (-50)	/35
3D Model	Link is Included Clear and Distinct Model accurately resembling physical prototype Clear CAD/OnShape Drawing with Isometric, Top, Front, and Side Views	/15
Originality	Design differs substantially from other designs Was the solution clearly the work of the competitors? Is the device a feasible real-world solution?	/10
Presentation	Were the benefits and principles of the design clearly explained? Was the design process clearly explained? Did all team members participate equally in the presentation? Do visual aids support presentation and explanation? Voice Articulation and Timing Preparation for Questions Response to Questions Penalties Misuse of time, if the presentation time is ≥ 1 minute over the allotted time, a penalty of 5 points per minute will be applied	/30
Teamwork	Did the members of the team appear to work well as a team? Did all members contribute to the problem-solving process?	/10
Penalties	Plagiarism (-50) Documents received after the deadline (-50) Absent team member (-25) Verbal disclosure of school during the presentation (-10)	



	Disclosure of school in presentation files/documents (-10) Disclosure of school in supporting audience members (-10)	
Total		/100

11 Appendix

Appendix A: Physical Prototyping Materials List

Item	Limited Market	Unit	Unit Price
Cardboard	2	12" x 12"	175
Foam Board	2	15" x 10"	100
Popsicle Sticks	3	20 pc	20
Wooden Skewers	4	5 pc	10
Aluminum wire	3	24"	200
String	3	12"	100
Toothpicks	2	30 pc	30
Assorted Elastic Rubber Band	1	20	5
Duct Tape	5	12"	35
Masking Tape	5	12"	25
Transparent Tape	5	12"	30
Straw	2	5	10
Clothing Hanger	3	1 pc	50
Springs	5	1 pc	30
Syringe	2	2 pc	150
Tube	4	12"	50
Zip Ties	2	5 pc	10
Push Pins	5	5 pc	5
Plastic Cups	10	1 pc	5
Water Bottle	3	1 x 500mL	10
Clothing Peg	5	1	5
Wire	2	12"	50



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**Paper is available at the shop but CAN NOT be used in prototype.*

