



ONTARIO ENGINEERING COMPETITION 2015

Senior Design

Rulebook

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Senior Team Design

1	Category Description & Objective.....	1
2	Category Logistics	1
2.1	Awards	1
2.2	Eligibility	1
2.3	Facilities Provided by the Organizing Committee.....	2
2.4	Optional Materials Provided by the Committee	2
2.5	Facilities Provided by the Competitors.....	2
2.6	Competition Personnel.....	2
2.7	Notes on Materials	3
3	Topic Selection	3
4	Competitor Deliverables	3
5	Judging.....	3
6	Scoring	3
7	Competition Procedures.....	4
7.1	Releasing the Statement of Theme	4
7.2	Judges' Briefing.....	4
7.3	Phase 1: Releasing the Problem Statement.....	4
7.4	Phase 2: Question Period	4
7.5	Phase 3: Development of the Solution and Preparation of Deliverables	5
7.6	Phase 4: Rest Period.....	5
7.7	Phase 5: Final Presentations.....	5
7.8	Multi-Stream Judging – Determination of Final Winners	6

1 Category Description & Objective

The goal of the Senior Team Design category is to encourage senior 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 category, competitors combine teamwork and problem solving skills to design, construct, test, and present a previously undisclosed project.

2 Category Logistics

2.1 Awards

First Place: \$1500

Second Place: \$1000

Third Place: \$500

2.2 Eligibility

- Up to 20 teams consisting of 4 individuals are accepted into Senior Team Design. Multidisciplinary teams are recommended, but not mandatory.
- All teams must meet all general entry requirements of OEC.
- Competitors must currently be in their third or higher academic year of engineering studies.

2.3 Facilities Provided by the Organizing Committee

- One (1) workspace per team with adequate facilities for design team meetings
- A large presentation room/area
- A “store” room for distribution of materials and tools
- One (1) lockable holding room for finished prototypes (may be combined with the store room provided there is an area for putting the prototypes that is not visible to other competitors during the competition)
- Materials, tools and safety equipment for assembly of the prototype
- A time piece
- Access to written copies of the topic, questions and answers
- Score sheets
- Feedback forms

2.4 Optional Materials Provided by the Committee

- Digital projector and computer for final presentations¹ - if a digital presentation is expected, the OC must offer computer facilities to teams which cannot provide their own
- Internet access
- List of competitor-provided materials – such materials must be inexpensive and available provincially. However, the committee is encouraged to provide all materials whenever possible.
- A supervised tool room and the appropriate safety equipment (required if power tools are being used)

2.5 Facilities Provided by the Competitors

- Student owned computer(s) or laptop(s) with legal copies of software and current anti-virus protection are permitted but not required
- If a digital projector and computer are provided for final presentations, then competitors must supply a USB key to transfer the final presentation and report to the presentation computer
- Materials as noted on the list from the OEC Organizing Committee (if applicable)

2.6 Competition Personnel

- One (1) Category Official
- One (1) timekeeper for the question period and solution development phases
- One (1) or more timekeeper(s) for the final presentation stage. Multiple timekeepers are needed only if there are multiple streams of judging.
- One (1) Head Judge
- Associate judges to complete the panel(s), with either three (3) or preferably five (5) judges in total on each panel
- Volunteers to carry out various support tasks

¹ Competitor computers will not be used for the presentations

2.7 Notes on Materials

It is at the discretion of the OEC Organizing Committee as to whether all teams are provided with the same bill of materials, or whether an “open market” store is set up and each team is given the same number of credits to “buy” materials from the store.

3 Topic Selection

In Senior Team Design, the topic will be sufficiently complex to challenge senior engineering students, while being reasonable to produce a physical prototype within the allotted time. A good topic will give teams the opportunity to use novel ideas and allows for multiple design possibilities.

The topic will be fully documented in writing and a copy will be given to each team. All necessary documentation must be provided to competitors and judges when the problem is presented. All restrictions/constraints will also be noted.

4 Competitor Deliverables

Teams in Senior 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. During the oral presentation, the team must demonstrate the design to show how well it meets the requirements and objectives of the project.

5 Judging

The most important aspects of evaluation in this category are the design and performance, teamwork, and the quality of the presentation.

The organizing committee should select judges that have appropriate experience in a range of disciplines. An odd number of judges must be used, preferably five (5), although three (3) is a minimum in any given panel. Multiple panels of judges may be used when required.

Judges deliberation will be conducted privately and the results will not be released until the final banquet. A feedback form from the judges will be compiled for each team and delivered to the teams individually.

6 Scoring

Design & Performance /40

Does the design work?

How well does the design meet the requirements of the project?

Note: The Design and Performance score of 40 percent may be broken down further as appropriate for the actual project. The breakdown of the Design and Performance marks will be revealed at the time that the project is revealed.

Penalties

Misuse of time – late handing in prototype-5/minute, up to -40

Team Work	/25
Did the members of the team appear to work well as a team?	
Did all members contribute to the problem solving process?	
Presentation	/20
Were the benefits and principles of the design clearly explained?	
Was time used appropriately?	
Did all team members participate equally in the presentation?	
Penalties	
Misuse of time – under-use by more than 3 minutes	-5/minute
Misuse of time – over-use	-10/minute
Originality	/15
Does the design differ substantially from other designs?	
Was the solution clearly the work of the competitors?	

7 Competition Procedures

7.1 Releasing the Statement of Theme

- The Statement of Theme will be published to competitors, judges and the public at least seven (7) days prior to start of the competition.
- Competitors will also receive a list of required materials (if applicable) at this time

7.2 Judges' Briefing

- The Judges' Briefing occurs prior to disclosing the Scope of Work to the competitors
- The Category Official will present the Scope of Work, answer questions about it, and make any final amendments to the problem as required by the consensus of the judges.
- The Category Official will also cover logistics of the competition related to judging.

7.3 Phase 1: Releasing the Problem Statement

- The Category Official, Timekeeper(s), and all competitors and judges must be physically present for Phase 1.
- The Problem Statement, which outlines full details of the problem and judging criteria, will be presented to all competitors and judges on Friday evening of the competition.
- The Category Official will present the Problem Statement orally, as well as handing out printed copies to competitors and judges at this time.
- Logistics of the materials store and final presentation will also be presented at this time.
- The order of presentation will also be announced at this time.
- Questions must be held until the Question Period.

7.4 Phase 2: Question Period

- Question Period immediately follows Phase 1, with duration of 20 minutes.
- During this time, competitors can ask the Category Official to clarify any point of the Problem Statement, competition rules or logistics of the competition.
- Only the Category Official 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.²

7.5 Phase 3: Development of the Solution and Preparation of Deliverables

- The teams will have six (6) hours to develop their solution, produce all required deliverables, and prepare their presentation for the judges. All the deliverables must be submitted to the Official before the allotted time expires. Competitors may finish before the end of the allotted time without penalty.
- The OEC Organizing Committee should provide additional time if there is a significant travel time between the location of the Question Period and the work rooms used for Phase 3.
- 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.
- Only questions related to the format of the deliverables will be answered during Phase 3. 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 must be submitted in writing. Answers will be distributed in writing to all teams at the same time. Answers may be provided at scheduled times, or accumulated until a significant number of questions have been asked, to ease logistics.
- Questions will not be accepted during the final 30 minutes of Phase 3.
- Questions and responses from Phase 3 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 for Phase 3.
- If the final presentation is to be submitted electronically (via USB or emailed to sr.design@oec2015.ca), it must be submitted to the Category Official any time before the expiry of the six (6) hours. Acceptable formats: .ppt or .pdf.
- Final prototypes must also be delivered to the holding room before the expiry of the six (6) hours. Late deliveries will be assessed a penalty.

7.6 Phase 4: Rest Period

- Competitors will be allowed a minimum of six (6) hours of rest period between the end of Phase 3 and the first of the Final Presentations on Saturday.

7.7 Phase 5: Final Presentations

- The order of presentation will be determined randomly.
- Each team is given a minimum of five (5) minutes to set up their presentation
- Each team is allowed 10 minutes to present their solution and deliverables.
- During this time, the team's design will be allowed to demonstrate their functioning prototype but will not be scored for testing at that time. Only the presentation will be scored during the presentation time. Dedicated testing time will follow after the presentations.

² Questions from the judges should be kept to a minimum during the Question Period, as their questions should be addressed during the Judges' Briefing.

- 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. A visual countdown must be given during the last 30 seconds of allotted time.
- 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.
- The testing session will be after all the presentations. They will be open to the public and the competition commissioners will be scoring the design solely on functionality and requirements of the design. The time allocated for each time for the testing will be disclosed during the briefing session.

7.8 Multi-Stream Judging – Determination of Final Winners

If multi-stream judging is implemented, each panel of judges will present their top four finalist teams to the other panel, and as a total group the judges will decide the outcome. The numeric scores will form the main basis for comparison. In the event of a tie, the team scoring higher on Design & Performance will be given the higher ranking.

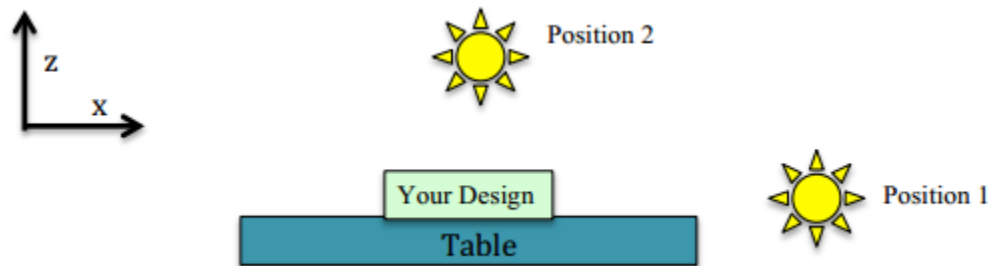
University of Toronto	ENG-LG 12 (9:00 AM: 9:30 AM)
University of Guelph	ENG-LG 13 (9:00 AM: 9:30 AM)
Lakehead University	ENG-LG 12 (9:30 AM: 10:00 AM)
Western University	ENG-LG 13 (9:30 AM: 10:00 AM)
University of Waterloo A	ENG-LG 12 (10:00 AM: 10:30 AM)
University of Waterloo B	ENG-LG 13 (10:00 AM: 10:30 AM)
Carleton University I	ENG-LG 12 (10:30 AM: 11:00 AM)
Carleton University II	ENG-LG 13(10:30 AM: 11:00 AM)
University of Windsor	ENG-LG 12 (11:00 AM: 11:30 AM)
Laurentian University	ENG-LG 13(11:00 AM: 11:30 AM)
University of Ontario Institute of Technology	ENG-LG 12 (11:30 AM: 12:00 PM)
Ryerson University	ENG-LG 13 (11:30 AM: 12:00 PM)
Lunch & Career Fair	ENG (12:00 PM - 1:00PM)
McMaster University	ENG-LG 12 (1:00PM - 1:30 PM)
Royal Military College of Canada	ENG-LG 13 (1:00PM - 1:30 PM)
Conestoga College	ENG-LG 12 (1:30PM - 2:00 PM)
York University	ENG-LG 13 (1:30PM - 2:00 PM)
University of Ottawa	ENG-LG 12 (2:00PM - 2:30 PM)
Queen's University	ENG-LG 13 (2:00PM - 2:30 PM)

**Ontario Engineering Competition 2015
Senior Design**

This document contains all details required to build the Senior Design prototype. It is the competitor's responsibility to read over this carefully.

1. Background Information

Environmental engineers across the world have been monitoring sea levels since the year 1870. Since then, the average sea water level has risen just over 10 inches. The melting of ice at both the North and South poles is causing the rise of water levels, having major effects of both the climate and the landscape of coastal regions. A geostationary satellite is being designed to monitor the depletion of arctic ice. A satellite is being launched on rocket that will deliver the satellite to an altitude of 35,786 km above the earth where it will be able to take observations and relay information back to a ground station on earth. The satellite requires 30 kW of power, which will be collected from the sun using solar panels. Each individual solar panel produces 5kW when the surface of the panel is perpendicular to the sun. Due to the changing positioning in the sun, the solar panels must be able to produce the required power for the satellite when the sun is stationed at Position 1, and then collect the same amount of power at Position 2.



2. Design Requirements

The solar panel mechanism that your team of engineers have been assigned to design will be housed in a cargo bay that is 8x10x5 inches. Once the rocket reaches orbit, the cargo bay housing will separate from the rocket, exposing the design. Your team will be given a test stand that is a mock creation of the cargo bay, and will attach your design to the satellite. On the test stand, an 8x10 rectangle is marked and is where your team must design and build to meet the dimension requirements. The whole design must completely fit inside the cargo bay to meet the mission requirements.

The cost of launching a satellite into space is directly related to the weight of the payload, or in this case, the satellite. It is required that the solar panel mechanism that your team is to design weighs less than 500g to minimize the cost of the launch. For every 10g over the projected weight, 2 points will be subtracted from your design score. Your team is given a budget of \$100 to buy materials from the shop, and for every 5 dollars over the budget; 4 points will be subtracted from your design score. Your team will be provided with 6 identical mock solar panels that collect 5kW of power when perpendicular to the sun. There will be an assortment of materials given to each team at the beginning of the competition that do not have to be purchased by your team.

Your prototype must incorporate LED lights which illuminates when the mechanism is initiated, when the solar panels are positioned at Position 1, and when the panels are positioned at Position 2. Broken and damaged solar panels will not be considered as part of the design as they do not collect energy. Any broken panels may be bought from the store if needed at a cost.

Assisting the design in the testing phase is prohibited. A team that physically assists their design during the testing phase will be scored zero for the testing portion of the competition. Teams will be allowed to interact with their design through initialization actions such as buttons, running the program, or operating the potentiometers that MUST be exposed at the edge of the design to avoid human interaction. Teams will be provided with a 9V battery to power the Arduino, the Team must power the Arduino during the testing phase through this battery. Teams will not be allowed to power the Arduino through a laptop connection.

3. Testing time

Total time per team: 180 seconds (3 minutes)

1. [60 second setup] Each team is allowed a 30 second setup time during which they are not allowed to transport any objects. During this time they must ensure that their design's base is securely fastened into the testing site. The team is not allowed to start testing until the competition commissioner tells them to start.
2. [60 seconds testing] Following the setup time, each team will have 60 seconds to perform the required tasks (transporting objects).
3. [60 second transition] Following the testing for each team is a 60 second transition. During this, the next team will be called forward. Immediately after this 60 second transition, the 30 second setup will start for the next team.

There will be two testing sites (both sites are in the same room, ENG 103), titled A and B. Each team will be informed if they will be testing on site A or B, and it is their responsibility to be present at the arena at the allotted time to the allotted arena.

Testing Site A = Teams presenting in ENG LG12

Testing Site B = Teams presenting in ENG LG13

Please refer to the delegate package or the general schedule to find your presentation room.

4. Penalties and bonus for design and testing

- [-5 pts] exceeding the dimensions of 8x10x5 inches.
- [-0.5 pts] per second for exceeding the time during testing for a maximum of 10 seconds. After these 10 seconds, the competition commissioner has the right to disqualify the team.
- [-2 pts] for every 10 grams over the weight limit of 500g
- [-4 pts] for every \$5 spent over budget of \$100
- [-5 pts] Misuse of time – under required presentation time of 5 min (-5%/min)
- [-5 pts] Misuse of time – over maximum presentation time limit of 10 min (-5/min)

5. Materials Provided

- 1 x Saw (6", 24 TPI)
- 6 mock solar panels
- 1 x Roll of electrical tape
- 1 x Box cutter
- 1 x Arduino Uno
- 1 x USB cable for Arduino
- 1 x Micro Servo
- 1 x Geared DC Motor (3-6V)
- 1 x TIP120 - NPN - Power Transistor
- 1 x TIP50 - NPN
- 1 x Half-sized breadboard
- 20 x Male-Male Jumper Wires
- 20 x Male-Female Jumper Wires
- 4 x AA Batteries
- 1 x AA Battery Case holder
- 1 x 9V Battery
- 1 x 9V Battery Holder
- 1 x 1N4148 - 75V 100mA Switching Diode
- 1 x 1N4001 - 50V 1A Rectifier Diode
- 2 x Tactile Buttons
- 1 x 500Ω - B - Potentiometer
- 1 x Styrofoam ball

6. Shop items and rules

- [\$5] per bundle of 5 Cafe stick (limit 5 per team)
- [\$5] per bundle of 2 Skewers (limit 5 per team)
- [\$5] per bundle of 2 Straight pins (limit 10 per team)
- [\$10] Glue stick (limit 5 per team)
- [\$5] Wooden Dowel (12" x 3/8") (limit 3 per team)
- [\$5] Wooden Dowel (12" x 3/16") (limit 3 per team)
- [\$10] Screwdriver (limit 1 per team)
- [\$5] Bundle of 3 for Zip ties (limit 10 bundles per team)
- [\$5] per bundle of 2 Clothespins (limit 5 per team)
- [\$10] per Metal Roasting Fork
- [\$5] per bundle of 3 Pencils
- [\$5] per Small Paper Cup

- [\$4] per Styrofoam Cup
 - [\$5] per bundle for 4 Golf Tees
 - [\$5] per 1 ft length of String
 - [\$4] per Binder Clip
 - [\$20] per roll of Electrical Tape
 - [\$15] per sheet of Foamcore
 - [\$10] per stick of Balsa Wood
 - [\$5] per bundle of 5 Elastic Bands
 - [\$1] per popsicle stick
1. Each team will be given a ‘store card’ which will allow access to the store. Only one person from a team will be allowed in the store at a time..
 2. Any member of the team may carry the store card.
 3. The shop will be closed 10 minutes before the prototype submission deadline. Anyone already in the queue at this time will be allowed to continue with the transactions. Anyone arriving in the queue at or after the last 10 minutes will not be allowed to access the store. For this period, the time limit of a person staying in the store will be reduced to 2 minutes/team(person) so as to accommodate more people in the queue.
 4. Please be considerate of others while in queue and in the store.
 5. Exchanging materials with other teams is prohibited and will result in an automatic disqualification.
 6. Stealing materials from the store will be an automatic disqualification.
 7. Bargaining, begging and discounts are not allowed.