Maryland Engineering Challenges
2019 Robot Challenge

High School Level – Grades 9 to 12
Middle School Level – Grades 6 to 8
April 14, 2019
(April 13 may be added as a 2nd day if needed)

Sponsored by the:
Institute of Electronic and Electrical Engineers (IEEE)

Engineer Contact:
Neville Jacobs — nevilleed@aol.com or 410.653.4176

Important Changes in 2018 - 2019

1) **This year the Robot Challenge will be open to Middle Schools as well as High School students, though scoring will be kept separate.**
2) **Last year Teachers requested a minor design change to reduce some problems that were frustrating their students. We can provide this change with a small price increase, the first we've had in over 20 years, but we believe it will make the project more enjoyable, and provide more reliable operation.**
3) **To keep our prices as low as possible, we have reluctantly eliminated the discount on the first kit as it seemed to favor some teams unfairly. Please communicate with the Engineer Contact above in the event of financial difficulties.**
4) **There will be additional information available on-line for Teachers that will supplement the information provided in hard-copy for the students. This should be particularly helpful for teachers that are doing the project for the first time.**

Important Dates

Coaches' Information and Hands-On Workshop

⇒ **Wednesday, November 14, 2018 4:00 p.m. to 7:00 p.m.**

This event is designed for Teachers and Mentors interested in coaching a team to learn about the project. Find out from the presentation if this Challenge is a good fit for your students. The Training is not a requirement for this project but is strongly recommended, particularly for first-time participants. There is no cost. Registration is strongly encouraged (by 11/12). Contact James at jkeffer@thebmi.org, or Nevilleed@aol.com.

Coaches' Hands-On Workshop

⇒ **Saturday, January 26, 2019 Begins at 10:00 a.m., ends at 2 p.m.**

Learn the practical aspects of this Challenge. Work with engineers to explore design and constructions aspects of the project. Especially helpful for first-time Coaches and/or those with little previous engineering experience. Registration required prior to 1/23/18. Lunch is included. There is no cost. Contact James at jkeffer@thebmi.org, or Nevilleed@aol.com.

Written Report Due

⇒ **Friday, March 29, 2019 Prior to 4:00 p.m.**

The team's Written Report should be submitted as a HARD COPY to the Baltimore Museum of Industry, and represent 25% of the total points awarded.

Registrations - two are required:

- **One, for participation and to obtain the Robot Kits and Manuals**
- **A second, to register for the arrival time at the Robot Challenge Event – information will be sent to teachers in March.**
- **If using Google Forms to register (see below), the first registration will generate a response e-mail that should be carefully saved and stored, so it can be updated or corrected by clicking the "Edit Response" block.**

To register for participation through the BMI, coaches should go to https://48278.blackbaudhosting.com/48278/MEC-Coach-Fee, and submit a $5 Coach's Fee.

If Teachers/Coaches know how many 2-leg teams and 4-leg teams they plan to have, they can contact the IEEE directly at Nevilleed@aol.com and they will be given a batch of team numbers and the name of their IEEE mentor (no fees if processed this way).
They should then assign a team number to each team, and have one representative from each **2-leg team** register their team using Google Forms by copying the following URL (note only ONE registration per team):
http://tinyurl.com/Robot-Challenge-2-Leg

4-leg teams should use the following:

http://tinyurl.com/Robot-Challenge-4-Leg

Kits can be picked up at one of the two Workshops (see below). Teachers/Coaches requiring more information may contact the IEEE directly at Nevilleed@aol.com (no fee). The project should be scheduled so that the robots are completed approximately 2 weeks before the Robot Challenge Event (for information on how to do this, see later).

• **Note that by signing up for participation in the project, each team is committing to participate in the Robot Challenge Event, as this portion of the project represents a major part of the educational adventure.**

The Robot Challenge Event (times are subject to change)

- ⇒ **Sunday, April 14, 2019 Doors open at 10:00 a.m. and it continues through the afternoon. There will be a light dinner for those who stay for the Awards held after the event.**
- ⇒ **Teams can register for an 11 AM starting time, or a 12:30 PM starting time, but every member of the team should plan to arrive at the Museum at least 30 minutes earlier (10:30 AM and 12 Noon) to register their team, pick up documentation, and have their team photo taken. If the robot is having some structural difficulties or cannot walk, the team should plan to arrive at 10 AM.**
- ⇒ **Any team unable to arrive for one of the two starting times, should contact Nevilleed@aol.com no later than April 9, 2019.**

While the judging of the Written Reports will take place several days earlier (25% of total points), the Challenge Event consists of a friendly competition with robots from teams from other schools (40% of the total points), followed by an Oral Presentation and discussions with a panel of engineer Judges (15% of total points). Judges will also review workmanship, teamwork, and artistic creativity (20% of total points). There may be additional details e-mailed to Coaches after registration.

Questions about Challenge specifications or judging should be sent to the Engineer Contact:
Neville Jacobs — nevilleed@aol.com or 410.653.4176

Museum questions?
James Keffer jkeffer@thebmi.org

THE CHALLENGE

Project simulates what a practicing engineer would experience while working on an engineering project. In addition to building a walking robot, there is the required artistic creation of the outer body of the robot, as well as the need to demonstrate both written and verbal communication skills. 8 levels of challenge are available, and all registered teams must participate in the Challenge Event to be held on April 14, 2019.

Objective: Design and build a motor-powered robot that walks under direction. The robot body can have any form, 2 or 4 legs, and have the ability to go over uneven terrain. Each leg shall be controlled by one student using two independent motors; the control and co-ordination of the motors, and the smoothness and speed of the robot, will be factors considered by the judges. Any wheels used should not touch the table surface or be visible. Manual control of the robot is a basic requirement, but extra credit (up to 15 points) will be given for any form of add-on automation that furthers the above goals. Kits can be obtained from IEEE, and range from $54

for a 2-leg robot with manual control (for 2 to 4 students), to an additional $198 for a 2-leg automation controller (other prices available upon request). Programming for most automation options is in C++.

Website: www.RobotChallenge.com Lots of information about the project, FAQ and helpful hints. Photos and results of previous Challenges.

ENGINEERING TEAM REQUIREMENT

Each team should have 2-8 students (2 to 4 for 2-leg robots, 4 to 8 for 4-leg robots). There is no limit to the number of teams a school may have. High School and Middle School students at Public, Private and Home schools, and Science Clubs are eligible to participate.

SPECIFICATIONS AND SUPPLIES

The competition involves four main components, a written report, the construction of the entry, the robot's performance on a course with hurdles each robot must climb over as it meets in competition with other entries, and an oral presentation before a panel of judges (which may include an optional video presentation), verbal communication skills, workmanship, teamwork, and artistic creativity. The Institute of Electrical and Electronic Engineers (IEEE) will supply a kit with the materials needed to make up the power unit and the control unit, and provide instructions, drawings, training materials, and mentors for the basic electrical equipment. Each team will be responsible for creating the robot body and building the power unit, control units, and shipping container, and should contact their mentors by e-mail at 2 week intervals (or if they have a problem). Students will need to provide the D-cell batteries and learn to coordinate the operation of the motors (learn to walk) as a team.

Kits will be distributed, with no shipping and handling fees, at the November 15 and January 26, 2019 Hands-on Workshops at the BMI. Other pick-ups by special arrangement with Nevilleed@aol.com. Any delivery by mail will be subject to a handling and shipping charge. No entries accepted after February 22, 2019. Kit prices are shown below.

- The cost for 2-leg kits is $54. A 4-leg robot is twice as much work, and is more challenging to operate. Additional 4-leg kits are $104. Classic Automation kits: $99 for 2-leg, $133 for 4-leg robots. NEW pre-assembled (re-usable) Automation Controller board kits: $198 for 2-leg, $266 for 4-leg robots. Other kits and one-year lease prices are available by request.
- Though Robot kits will be available in November 2018, or earlier by special request, teams are requested to try to complete their projects shortly before the competition dates in April. To meet the early April completion objective, coaches will need to determine how many hours a week the students will work on the project, then use the figures below to estimate when the students should begin, based on the following:
  2-leg Robot (21 hours required*), 3 hours a week (7 weeks): start mid-February.
  2 hours a week (14 weeks): start early January
  1 hour a week (21 weeks): start early November
  * These numbers can vary based on student skills, the number of students in a team and their absences (we have tried to allow for winter and spring breaks and snow days). Building the robot body with a 3-D printer may reduce this figure by 4 hours.

- Allow up to 28 hours for a 4-leg manually controlled robot, 30 hours for a 2-leg robot with basic automation, and up to 36 hours for full automation.
- Teams planning to automate their robot would need to start significantly earlier than the dates shown above, but coaches doing this project for the first time are strongly advised to build just the 2-leg robots with manual control.
- As mentioned earlier, teams ordering kits are required to participate in the Robot Challenge at either starting time, on April 14, 2019.
- Teachers and Coaches are urged to attend the no-charge training sessions on November 15, 2018, 4 to 7 PM; and/or January 26, 2019, 10 AM to 2 PM (lunch included).
- For more information, please call the organizers on 410-653-4176.

JUDGING GUIDELINES

I. Design Development and Fabrication — Competition value: 20 points*

The team must use the parts provided in the kit, substitutions are not allowed, but additions are permitted. Wheels (if used, though not recommended) may not touch the table or be visible. Creativity and Artistry are important factors, and the robot body must be designed such that the team can fully expose all parts of the body and mechanism for inspection by the judges.

* Awarded during the Oral Presentation, based on the judges' findings.

II. Written Report — Competition value: 25 points

Points will be awarded for creativity, originality, neatness, grammar, sketches, photos, and the Robot's artistic body covering.

III. Performance Demonstration — Competition value: 40 points

The course will have 2 tracks on an 8 foot table, with the start and finish lines 6 feet apart. Two half-inch high hurdles (known in a Hardware store as a "quarter-round") will have to be climbed over. The robots will first race two at a time in manual mode, and team members (one per leg) must stay at their side of the table. Points will be awarded for the time taken, the smoothness of the robot's movements, and the coordination and cooperation of the operating team. Points are lost if team members touch their robot or interfere with their opponent. In the event that some degree of automation has been added, the robot shall run a second or third time in that mode for bonus points.

IV. Oral Presentation to Judges (and review of fabrication)* — Competition value: 15 points

GOOD LUCK TO YOUR TEAM!