2006 ASEE MODEL DESIGN COMPETITION

Sponsored by the Two Year College Division of ASEE

Date: September 19, 2005
Dear Colleague,

On behalf of the American Society for Engineering Education (ASEE) - Two Year College Division (TYCD), we invite you to encourage the submission of student design projects for the 8th Annual ASEE Lower Division MODEL DESIGN COMPETITION. This event will be held in conjunction with the 2006 ASEE Annual Convention, June 18-21, 2006 in Chicago, IL. This competition is open to 2nd and 1st year students at four and two year colleges and universities.

In this year's competition student teams will build a robot capable of depositing standard ping-pong balls into pockets located in the corners of a large, square track. The robots must adhere to the guidelines of the model design competition (attached). An oral presentation and written report are included as part of the competition.

The main reason for this competition is for students to gain a better understanding of the design process from start to finish. Designing and building something from an idea is probably why they chose engineering in the first place. Use this design competition as a platform to reinforce their ideas and have some *engineering fun!* We hope to see you and your students' entries in Chicago.

Please find enclosed the guidelines and registration forms for this event. The interest and registration forms are on the back of this letter.

Sincerely,

Paul E. Gordy - ASEE TYCD Competition Coordinator
Phone: 757-822-7175
Fax: 757-427-0327
Email: PGordy@tcc.edu

John Wadach
Phone: 585-292-2488
Email: JWADACH@monroecc.edu

Competition web page: **http://www.tcc.edu/faculty/webpages/PGordy/ASEE/index.html**

Results from the

7th Annual ASEE Model Design Competition

June 13, 2005 - Portland, Oregon

The ASEE Model Design Competition is a design/build competition for freshmen & sophomore engineering students at 2-year and 4-year colleges. The competition is held each year during the ASEE Annual Convention. The competition typically involves building an autonomous, battery-powered vehicle to navigate some sort of challenging track. The recent competition in Portland required robots to deposit ping pong balls in four corner pockets of an 8' X 8' plywood track in less than one minute. Scoring for the competition was based on the total number of balls deposited in the pockets as well as a presentation by student team members before a panel of judges.

Ten teams were registered for the competition, but two teams dropped out just before the event, as they were unable to produce robots to complete the task (a common problem in this challenging event). The eight teams that competed brought impressive robots to the event. The results were as follows:

1st Place - Monroe Community College, Rochester, NY
2nd Place – Cedarville University, Cedarville, OH
3rd Place – Jefferson Community College, Watertown, NY

Consider bringing a team from your college to next year's competition on June 19, 2006 in Chicago, IL. For more information or a copy of next year's rules, please contact Paul Gordy (Pgordy@tcc.edu, 757-822-7175) or John Wadach, Jwadach@monroecc.edu, 585-292-2488). Also visit the competition website at
http://www.tcc.edu/faculty/webpages/PGordy/ASEE/index.html

Team members pose with their robots after the robot trials in Portland, OR.

2006 ASEE MODEL

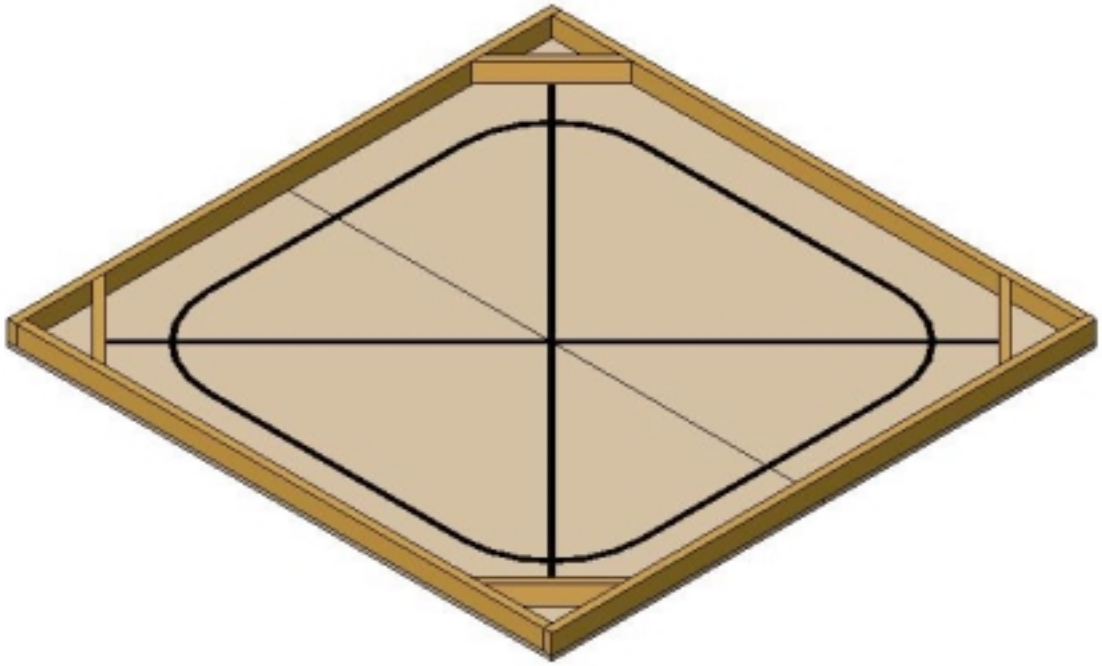
DESIGN COMPETITION
Chicago, Illinois
MODEL COMPETITION GUIDELINES

The American Society for Engineering Education (ASEE) Two-Year College Division (TYCD), Model Design Competition will be held Monday, June 19, 2006 in conjunction with the ASEE Annual Convention in Chicago, Illinois.

Objective:

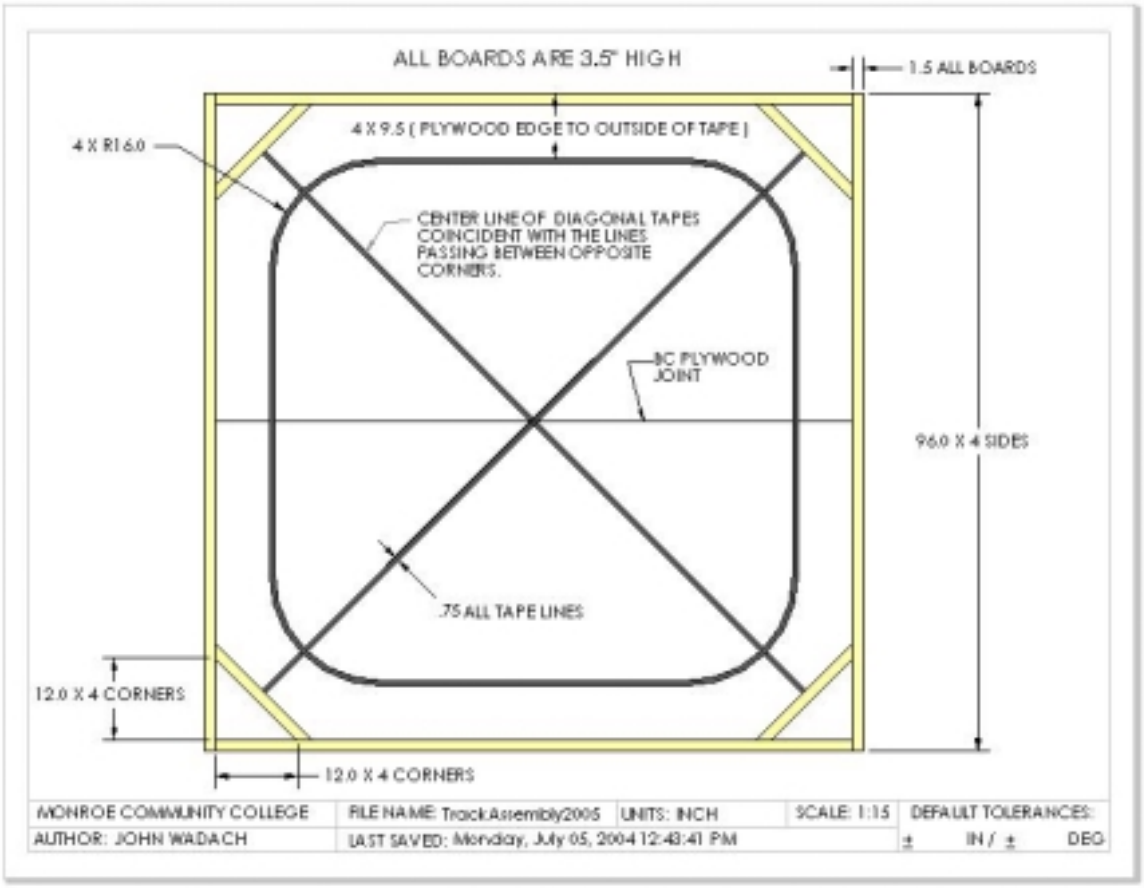
To design and build a zero-emission robot that sequentially deposits a total of twelve ping-pong balls into four triangular pockets in less than 120 seconds. An isometric view of the track is shown below.

Figure 1: Isometric View of Track



Track Specifications:

Figure 2: Top View of Track (Not to scale due to JPEG resizing)



Track Materials:

1. Five 2" X 4" X 8' boards (actual dimensions 1.5" X 3.5" X 8').
2. Two 4' X 8' sheets of BC plywood.
3. One roll of ¾" wide black vinyl electrical tape
4. Fasteners

Construction Procedures:

1. Butt the two sheets of plywood together. The elevation difference between the two sheets along the joint must be less than 1/16". If the elevation difference is greater than 1/16" a support structure should be added beneath the plywood. If an elevation difference of greater than 1/16" is present during the competition the judges will

determine a temporary remedy such as standing on the joint without interfering with the robot.

2. Snap a chalk line or draw a pencil line between both pairs of opposite plywood corners that will be used to affix diagonal lines of tape onto.

3. Layout the outside edge of the oval line of tape. The outside edge of the straight sections of the oval line of tape must be 9.5" from the outside edge of the plywood surface. All corner arcs have radii of 16.0".

4. Fasten the perimeter 2 X 4 boards to the plywood.

5. Cut the 2 X 4 corner boards to length using a 45° miter. Fasten the boards to the track. Make sure that all fasteners are flush with the surface of the boards.

6. Affix two pieces electrical tape so that the centerline of each piece of tape is coincident with one of the diagonal layout lines.

7. Affix the oval tape so that the outside edge of the tape is coincident with the layout lines.

Vehicle Specifications:

Allowable Energy Sources:
Any energy source is allowed as long as it is completely contained within the robot and does not create or emit any gaseous, liquid, or solid materials. Energy sources must not present any safety hazards to participants or spectators.

Maximum Robot Size at Start:
At the start of a trial the robot and balls must be contained within the following dimensions:

Height: 6.0 inches
Width: 8.0 inches
Length: 12.0 inches

Before each trial the judges may use a measuring template that is placed around the robot to determine if the robot is within the maximum size constraints. Once a trial has begun the robot may unfold into any size.

Components, Fabrication and Cost:
Team members using tools and component parts, which are commonly available to the general public must perform all fabrication. Use of commercially available vehicles, robots, or kits such as RC cars, Legos, K-nex, Fischer-Technics, or erector sets may not be used for the chassis or major subassemblies of the robot. Individual parts from these cars or kits may be integrated into a team's robot. The total cost of all components must not exceed $350.

Ping-Pong Ball Size:
There is some variation in ping-pong ball sizes. The official diameter of a ping-pong ball changed from 38mm to 40mm in October of 2000. Additionally, even nominal 38mm ping-pong balls may vary somewhat. **For this competition, the size of a ping-pong ball must be at least 37.25mm.** The judges may use a measuring device, such as a metal plate with a 37.25mm hole through which approved ping-pong balls should not be able to pass through. Teams should be ready to present their ping-pong balls for inspection if requested to do so by the judges. Also note that a good source for purchasing ping-pong balls online ($0.95/dozen or $27.90 for 21 dozen with shipping) is:
http://store.rebeccas.com/store/merchant.mvc?Screen=PROD&Product_Code=BLS575&Category_Code=

Robot Navigation:
A trial will be initiated when a team member presses or pulls a button, lever, string, or other starting mechanism on the robot. Energy from the team member's body may not be used to propel the robot or cause components to move on the robot. Once any portion of the robot begins moving the team members may not touch the robot. The robot must be capable of completing the tasks without any input from the team. Team members may not operate radio, infrared, ultrasonic, electrical, or other remote controls once the robot begins moving.

Robot Inspection:
Prior to each trial the judges will inspect the robot for the following:
1) The robot must meet the required specifications for dimensions, allowable energy sources and components, and other specifications.
2) The robot must pass a safety inspection. Any robot that presents a safety hazard, or has the potential to damage any property or the track will not be allowed to perform the trial.

Robot Testing:

1) The robot must begin with some portion of it on or above the joint between the two pieces of plywood. The robot including ping-pong balls must begin within the 8"X12"X 6" maximum size. After a team initiates a trial the robot may change into any size.

2) The robot may operate for a maximum of 120 seconds after the judge gives the command to start.

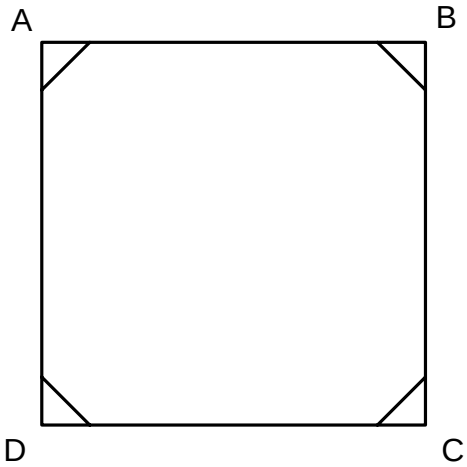
3) Each team must provide their own ping-pong balls and the balls may not be modified in any way. Robots may contain a maximum of 12 ping-pong balls at the start of the trial.

   The ping-pong balls may not be taped, packaged, or bound together in any fashion when they are inside the pockets on the track (i.e., the balls must be loose after being placed in the pockets). Additionally, no materials other than the ping-pong balls

may be left in the pockets by the robot or the balls in that pocket will not be counted for scoring purposes.

4) The robot may not clamp or hook onto, bore into, or use adhesives or other materials to stick to the track or boards. The robot may not damage, mark, or leave any residue on the track.

Top View of Track
with Pockets Labeled A-D



The objective of a trial is to sequentially deposit one ping-pong ball at a time in each of the four corner pockets in either a clockwise (A-B-C-D) or counter-clockwise (A-D-C-B) direction. A sequence may start in any of the four pockets. If a ball is emitted from the robot and fails to come to rest in a pocket or is deposited in a pocket that does not continue a clockwise or counter-clockwise sequence, the current sequence will be terminated.

A minimum of 3 seconds must elapse after a ball has been deposited in a pocket before a second ball may be deposited into a pocket. If a ball is deposited in a pocket in less than 3 seconds after the previous ball has been deposited, then the current ball will be ignored in the scoring and the sequence will be broken. A new sequence will begin with the first ball deposited after the 3-second period.

If two or more balls are deposited into one or several pockets within a 3 second period, then only the first ball will count in the score and all other balls will be ignored in the scoring. When multiple balls are deposited within a 3 second period the current sequence is broken and a new sequence begins with the first ball to be deposited after the 3-second period.

6) Points will be awarded using the following system.

1 Point for 1st ball of a sequence that is deposited in a pocket
2 Points for 2nd ball of a sequence that is deposited in a pocket
3 Points for 3rd ball of a sequence that is deposited in a pocket
4 Points for 4th ball of a sequence that is deposited in a pocket

5 Points for 5th ball of a sequence that is deposited in a pocket
6 Points for 6th ball of a sequence that is deposited in a pocket
7 Points for 7th ball of a sequence that is deposited in a pocket
8 Points for 8th ball of a sequence that is deposited in a pocket
9 Points for 9th ball of a sequence that is deposited in a pocket
10 Points for 10th ball of a sequence that is deposited in a pocket
11 Points for 11th ball of a sequence that is deposited in a pocket
12 Points for 12th ball of a sequence that is deposited in a pocket

A ball is considered to be in a pocket if it is within the three vertical planes of the inside triangle of the pocket and completely below the horizontal plane of the top surface of the 2"X4" boards. A robot is considered to be outside of the pocket if it is completely outside of the volume of the pocket described above.

7) The maximum number of points that can be earned in a trial is the sum of 1+2+3+4+5+6+7+8+9+10+11+12=78. If a robot earns a perfect score of 78 points, the score will be multiplied by a bonus factor. The bonus factor is computed by dividing 120 seconds by the time in seconds needed for the robot to earn 78 points. For example if a robot earns 78 points in 60 seconds, the bonus factor will be (120s/60s = 2). The final score for the trial will then be 78 x 2 = 156.

8) Scoring Examples (These examples show scoring for clockwise sequences. The same scoring principles apply for corresponding counter-clockwise sequences)

i. All 12 balls were deposited into pocket A within a 3 second period.

Only one point will be earned for the first ball deposited.

Ball #	1	2	3	4	5	6	7	8	9	10	11	12	**Total**
Pocket	A	A	A	A	A	A	A	A	A	A	A	A	**Points**
Points	1	0	0	0	0	0	0	0	0	0	0	0	**1**

ii. All 12 balls were deposited into pocket A with at least 3 second elapsing between each ball's entry into the pocket.

One point will be earned for each ball deposited for a total score of 12 points. Each ball is the first ball in a new sequence and therefore earns only one point.

Ball #	1	2	3	4	5	6	7	8	9	10	11	12	**Total**
Pocket	A	A	A	A	A	A	A	A	A	A	A	A	**Points**
Points	1	1	1	1	1	1	1	1	1	1	1	1	**12**

iii. Three balls were deposited into each pocket within a 3 second period.

Only one point will be earned for the first ball deposited.

Ball #	1	2	3	4	5	6	7	8	9	10	11	12	**Total**
Pocket	A	A	A	B	B	B	C	C	C	D	D	D	**Points**
Points	1	0	0	0	0	0	0	0	0	0	0	0	**1**

iv. One ball was deposited in pocket A, three or more seconds later one ball was deposited in pocket B, three or more seconds later one ball was deposited in pocket C, three or more seconds later one ball was deposited in pocket D. The robot then repeated the above sequence 2 more times. The 12 balls are deposited in a total of 60 seconds.

Ball #	1	2	3	4	5	6	7	8	9	10	11	12	**Total**
Pocket	A	B	C	D	A	B	C	D	A	B	C	D	**Points**
Points	1	2	3	4	5	6	7	8	9	10	11	12	**78**

Since the robot earned a perfect score of 78 points, the total points are multiplied by the bonus factor to obtain the total score.

Total score = 78 points X (120s/60s) = 156 points.

v. One ball was deposited in pocket A, the next ball emitted fails to enter a pocket, three or more seconds later after the ball was deposited in pocket A. one ball was deposited in pocket B, three or more seconds later one ball was deposited in pocket C, three or more seconds later one ball was deposited in pocket D. The robot then repeated the above sequence until all 12 balls were emitted.

When the second ball emitted from the robot failed to enter a pocket the sequence that began at A was terminated and the third ball emitted into pocket B earned one point because it was the first ball of a new sequence.

Ball #	1	2	3	4	5	6	7	8	9	10	11	12	**Total**
Pocket	A	X	B	C	D	A	X	B	C	D	A	X	**Points**
Points	1	0	1	2	3	4	0	1	2	3	4	0	**21**

Key: X denotes a ball that was emitted from the robot but did not enter a pocket.

vi. One ball was deposited in pocket A, three or more seconds later one ball was deposited in pocket B, three or more seconds later one ball was deposited in pocket D. This pattern of A-B-D was repeated three more times.

The first ball deposited in pocket A earns 1 point, the second ball in pocket B earns 2 points, the third ball deposited in pocket D earns 1 point because the clockwise

sequence was broken at pocket C. The ball deposited in pocket D is therefore the first ball deposited in a new sequence and therefore earns 1 point. On the second and third repetitions of the sequence, the balls deposited in pockets A, B, and D will earn 2, 3, and 1 point respectively.

Ball #	1	2	3	4	5	6	7	8	9	10	11	12	**Total**
Pocket	A	B	D	A	B	D	A	B	D	A	B	D	**Points**
Points	1	2	1	2	3	1	2	3	1	2	3	1	**22**

vii. One ball was deposited in pocket A, three or more seconds later one ball was deposited in pocket B, three or more seconds later one ball was deposited in pocket C, three or more seconds later two balls were deposited in pocket D. The robot then repeated the above sequence until all the balls were emitted from the robot.

The first ball deposited in pocket A earns 1 point, the second ball in pocket B earns 2 points, and the third ball deposited in pocket C earns 3 points. If the two balls deposited into pocket D are deposited within 3 seconds of each other then the fourth ball deposited in pocket D earns 4 points and the fifth ball deposited will be ignored in the scoring. A new sequence begins in pocket A because more than one ball was deposited in the pocket D within 3 seconds. .

Ball #	1	2	3	4	5	6	7	8	9	10	11	12	**Total**
Pocket	A	B	C	D	D	A	B	C	D	D	A	B	**Points**
Points	1	2	3	4	0	1	2	3	4	0	1	2	**23**

viii. In example vii, if more than three seconds elapsed between the first and second balls deposited into pocket D on the first repetition of example vii, the first ball would still earn 4 points but the second ball would earn 1 point. The second ball deposited in pocket D begins a new sequence.

Ball #	1	2	3	4	5	6	7	8	9	10	11	12	**Total**
Pocket	A	B	C	D	D	A	B	C	D	D	A	B	**Points**
Points	1	2	3	4	1	2	3	4	5	1	1	2	**29**

ix. One ball deposited in pocket A, three or more seconds later one ball is deposited in pocket B, three or more seconds later one ball is deposited in pocket C, three or more seconds later one ball is deposited in pocket D. On the second repetition the robot reversed direction and deposited one ball in pocket C, three or more seconds later one ball is deposited in pocket B, three or more seconds later one ball is deposited in pocket A, three or more seconds later one ball is deposited in pocket D.

Once the robot reverses direction the current clockwise sequence is broken and a new sequence begins in pocket C.

Ball #	1	2	3	4	5	6	7	8	9	10	11	12	**Total**
Pocket	A	B	C	D	C	B	A	D					**Points**
Points	1	2	3	4	1	2	3	4					**20**

9) Each team will be allowed to make four trials. The total testing score will be equal to the sum of the points earned in the two trials with the highest point totals.

10) The order of testing will be determined by random draw. Each team will have one minute to begin a trial after being called. All teams will be called for a trial in a current round before any teams begin the next round of testing. If time permits, there will be a halftime break of approximately 10 minutes after each team has attempted 2 trials.

11) Teams may not make practice runs after the start of the robot testing session or during halftime.

12) Teams may make changes or repairs to their robots between trials.

Oral Presentation:

Prior to the testing of the vehicles, each team shall make an oral presentation that is 10 minutes in duration. The judges may reduce the length of the presentations if the number of entries does not allow the presentation component of the competition to be completed in allotted time. The oral presentation will be followed by questions from the judges. If time allows, the judges may allow additional questions from the audience.

The objective of the oral presentation is to describe the engineering design process that a team used to arrive at the final solution. The oral presentations should include the components listed below. Each of the 6 topics is worth 5 points. A perfect score for the oral presentation is 30 points.

1. Problem Identification:
   What tasks must the robot perform?
   What constraints were present that limited the design choices?
   What technical problems had to be solved in order for the robot to perform the required tasks?

2. Preliminary Ideas:
   Describe the ideas that were generated for solving the problem.
   Were these ideas adaptations from existing products?
   What criteria were used to narrow the list of possible solutions?

3. Refinement:
   What physical, CAD, and/or analytical models were built in order to evaluate the design alternatives?

4. Analysis:
   What data and results were obtained from the models?
   How did this information help guide the design process toward a final solution?

5. Final Solution:
   Display images of the robot, wiring schematics, and flow charts of programs to describe how it works and how it was fabricated. An itemized cost analysis should also be shown.

6. Presentation Quality:
   The following items will be evaluated by the judges to determine the quality of each presentation: team appearance, organization, vocal quality, visual aids.

Written Report:

Prior to the oral presentation, each team must present the judges with 5 copies of their written report. The written report should include the components listed below. Each of the 3 topics is worth 5 points. A perfect score for the written report is 15 points.

1. Executive Summary:
   This summary should be no more than one page using a 12 point font and single spaced. The summary should succinctly describe the problem that was solved, why the robot is an optimal solution to the problem, results of pre-competition testing, and a summary of the cost of the robot.

2. CAD Images, Circuit Schematics, and Programming Flowcharts:
   CAD images should adequately describe the form and function of the robot.
   Circuit schematics should convey how the circuitry was constructed and how it works.
   If a micro-controller was used, a descriptive flowchart of the programming code should be displayed.

3. Bill of Materials:
   The bill of materials should include the following information for each component of the robot: part name, size or part number, vendor name, quantity used, unit price, and total price. You should also sum all the total prices to display the overall cost of the components of your robot. This cost must be less than $350. For components that you did not have to purchase you must still list a vendor where the item could be purchased along with the unit and total price. These prices must be included in the overall cost of the robot.

Scoring:
The final score for a team will be equal to the sum of the oral presentation score, written report score, and the two highest scores from the robot testing. A team will be disqualified from the competition if they fail to make an oral presentation or do not submit a written report.

Rule Interpretations:

Before the date of the competition:
Contact Paul Gordy or John Wadach regarding competition rules, specification, or schedules.

Paul E. Gordy
Tidewater Community College
1700 College Crescent
Virginia Beach, VA 23453
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Email: PGordy@tcc.edu

John Wadach
Monroe Community College
1000 E. Henrietta Road
Rochester, NY 14623
Phone: 585-292-2488
Email: JWADACH@monroecc.edu

On the date of the competition:
The judges will interpret the intent of the rules and make all decisions. If the judges determine that a team is in violation of the intent of any rule or specification, they may either deduct points or disqualify the team. All decisions by the judges are final and may not be appealed.

PROJECT TEAM / ENTRY LIMITATIONS:

Each team must have at least one faculty advisor and at least 2 student members but no more than 10 student members. Each team member must primarily be enrolled in freshmen or sophomore level classes. Each school may have up to three teams entered in the competition. If a school has more than one entry then each team must represent a unique solution to the design problem.

PROJECT INTEREST AND REGISTRATION FORMS:

Please find the entry forms on a separate page. The Interest Form must be received no later than March 1, 2006. A Registration Form for each model design team must be received no later than June 1, 2006.

ASEE ANNUAL CONVENTION PASSES:

It is not required that student team members or faculty advisors be registered for the ASEE Annual Convention. Passes will be provided for all team members and advisors so that they can enter the conference area and exhibition area on the day of the competition. Details for obtaining passes will be made available a couple of weeks prior to the competition.

COMPETITION TIMELINE:

The specific time and location of the oral presentations and robot testing will be sent to all teams and published in the ASEE Final Program and Proceedings booklet. The overall format of the competition is given below.

Morning: **Oral Presentations and Evaluations of Written Reports**

Lunch: **A lunch may be provided for students and faculty advisors. Students are encouraged to sit with students from other teams during lunch.**

Afternoon: **Robot Testing and Awards**

PRACTICE SESSION:

The official track will be available in the Exhibition Hall for teams to practice on prior to and following the oral presentations. Teams should be considerate and only use the track for brief periods if other teams are waiting to use the track. No practice runs may be made during the oral presentations, after the robot testing has begun, or during the halftime period.

AWARDS:

First, second, and third-place teams will receive plaques.

SUNY TYESA COMPETITION

The 2006 State University of New York Two Year Engineering Science Association (SUNY TYESA) will host a design-build competition on or about Friday, May 5, 2006 at one of the SUNY community college campuses. SUNY TYESA will use the same rules and project as the 2006 ASEE Design Competition. Teams interested in participating in the SUNY TYESA competition should contact John Wadach or visit the SUNY TYESA website at: tyesa.org

2006 ASEE Model Design Competition Registration Form

Name of college/university: _____

Team Name: _____

Name of faculty advisor(s): _____

Mailing Address: _____

Phone: _____ Fax: _____

Email (print clearly): _____

Student team captain: _____

Other student team members:

1. _____ 2. _____ 3. _____

4. _____ 5. _____ 6. _____

7. _____ 8. _____ 9. _____

Which students/advisors need badges for the convention center? (Badges are needed if you are not registered for the convention).

Circle one: All need badges. None need badges. Only those listed below need badges.

Please submit this form to :

Paul E. Gordy - ASEE TYCD Competition Coordinator
Tidewater Community College
1700 College Crescent
Virginia Beach, VA 23453
Phone: 757-822-7175
Fax: 757-427-0327
Email: PGordy@tcc.edu

Return one copy of this form for each team entered by June 1, 2006 (by US mail , fax, or email)

2006 ASEE Model Design Competition Interest Form

Name of college/university: _____

Name of faculty advisor(s): _____

Mailing Address: _____

Phone: _____ Fax: _____

Email (print clearly): _____

Number of model entries expected (maximum of 3): _____

Please submit this form to:

Paul E. Gordy - ASEE TYCD Competition Coordinator
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1700 College Crescent
Virginia Beach, VA 23453
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Email: PGordy@tcc.edu

Return this form by March 1, 2006 (by US mail , fax, or email)