**ECE/ME 101**
**Engineering Careers and Concepts**
**Saginaw Valley State University**

# TEAM DESIGN PROJECT
# "Search & Destroy"

## Background

You will be assigned to teams to complete an engineering design project. Each team will "invent" its own name. Your team is required to complete each step of the design process as presented in class. Your instructors recognize that your background is not sufficient to complete each step of the process as would a graduate engineer yet we expect you to do your best. You are born as creative as the next person so we expect a rather complete consideration of possible alternatives.

We expect your team to carry this project through to conclusion. That is, you will have completed the design process steps listed below and discussed in class.

1. Problem Identification - understanding what is needed.
2. Invention.
   a. Generation of Alternatives - research and ideation.
   b. Selection of Your Single Alternative - defining criteria for your choice.
   c. Refinement of Chosen Alternative - working out details.
3. Analysis and Testing - assuring design will be successful.
4. Decision on Final Version - refining final version.
5. Implementation - prototype construction and testing.

**NOTE: The design competition will be conducted in the presence of classmates, family and friends, instructors, as well as other engineering faculty. The final report will consist of two parts: a written report and an oral report. THE FORMAT TO BE USED CAN BE FOUND IN THE DOCUMENT TITLED *Report Format for ECE/ME 101* that can be found on the Modules page in Canvas.**

## Problem Statement

The goal is to design and construct a vehicle using the Lego Mindstorm Robot Inventor kit that can navigate a simple course on the floor defined by black tape and yellow tape. The vehicle must then climb a ramp to a "fighting circle" and do battle with another vehicle. There will be two identical, non-intersecting floor courses leading to separate ramps. So two vehicles will start simultaneously and compete against one-another but the only contact between robots will occur at the top of the ramps in the fighting circle. The winner will be the surviving vehicle or the vehicle closest to the circle's center at the end of the heat. The floor-course is in the lobby outside the P118 lab.

**Competition Rules**

1. The vehicle must be autonomous and controlled by the Mindstorm on-board computer. No remote power, control wires, or remote-control links are allowed.

2. The vehicle's exterior dimensions at the start of each run must not exceed 30 cm x 30 cm x 30 cm. An offensive or defensive device may extend beyond this limit once activated, but cannot be activated before the start of the run.

3. The vehicle must be placed within the start area on the floor and activated by an on-board device (e.g., switch, mechanical release, etc.) on the vehicle. Team members may not activate any other device before the start or after the starting signal. Vehicles cannot be running and dropped to start.

4. The vehicle and auxiliary devices must be powered by one or more of the three provided electric servo motors. No additional Lego parts may be used other than those provided in the kit.

5. When on the ramp the vehicle must run within the 30 cm wide track. It may not run on top of the side rails.

6. At the end of each heat, the vehicle whose center, as determined by said vehicles length width, and height, is closest to the center of the fighting circle will be declared the winner. Alternatively, if one vehicle pushes the other off the circle or otherwise disables it, the surviving vehicle will be declared the winner. If neither vehicle attains the top of the hill during the heat or if both vehicles depart the circle, no winner will be declared for that race.

7. The competition will be based upon a double elimination format. A tournament grid will be set up and there will be a winner's and loser's bracket. Once a vehicle loses, it will immediately move to the loser's bracket and continue racing until it loses for a second time. This will allow teams who lose once and fight their way back to the final heat by winning the remainder of their races. The last race will involve the top car in the winner's bracket and the top car in the loser's bracket. If the winner's bracket car wins the race, the competition is over and that car is declared the overall winner. If the loser's bracket car comes out the winner, another race will be run because the winner's bracket car will have then lost only once. Modifications to the vehicle are permitted between (but not during) runs.

8. No pre-built chassis are allowed. The battery charger may not be on board the vehicle.

9. No alteration of supplied components is allowed.

10. A 30 cm x 30 cm square "virtual no-entry-by-opponent" zone will exist at the top of each ramp on the fighting circle. This is to prevent the first vehicle up from blocking the other's ascent to the circle. Once both vehicles are completely in the circle and off of the ramps, the "no-entry" zone will no longer exist.

11. There is a 3-minute maximum time limit for each match. At the 3-minute mark, the robot whose center of gravity is closest to the center of the fighting circle will be declared the

winner of that match.

**NOTE: Some specifications may be changed during the semester, but you will receive the earliest possible notification.**

**Design Project Evaluation***

You have noted that 50 percent of your course grade is associated with this project and other group activities. The design project requirements are:

1. **Rolling Chassis**
    a. A vehicle chassis is assembled and vehicle is capable of rolling. Wheels may or may not roll depending on gear train configuration.
2. **Powered Chassis**
    a. A vehicle chassis is assembled and must demonstrate to class that the vehicle is capable of moving one foot in any direction under its own power by the vehicle hub.
3. **Preliminary Design Report**
4. **Offensive/Defensive Mechanism & Control Program**
    a. Vehicle chassis constructed with offensive and/or defensive mechanism and must be able to explain control program functionality to class.
    b. Must be able to explain to class how offensive and/or defensive mechanism operates.
5. **Complete Vehicle Inspection**
    a. Vehicle is fully assembled and capable of following the robot course including the ramp.
    b. Must describe to the class how the robot navigates the course and how it will win the competition.
    c. Modifications of the robot are still allowed until the competition starts.
6. **Design Competition**
7. **Oral Presentation**
8. **Final Design Report**

Refer to the class schedule for task/assignment due dates.

***All design team members may not receive the same number of points. Your individual participation in your team will be reflected in the score you receive.**

**From Your Instructors**

We expect a number of events to occur in this project. Some of you will be remarkably successful... and some of you will experience failures along the way. This is not unusual. One common occurrence will be related to the iterative nature of design. Your team will probably go "back to the drawing board" more than once and this is normal. In addition, you will probably struggle to meet deadlines. This is also normal. But there are a few concepts that will keep you on track and on schedule:

1. **Effective Project Management.** Develop a project schedule of events along with team member responsibilities. Leave enough time for testing. Use realistic test conditions.

2. **Teamwork.** While a leader may emerge from your group, you must all pull together to accomplish this project. Every team member has skills to bring to the project and an

appropriate division of effort will be critical to your success.

3. **Don't Suffer in Silence.** If parts of your kit are broken or missing or if a teammate is acting inappropriately, you do not have to suffer in silence. It is okay to ask for help. We want you to be successful. Please contact your instructors sooner rather than later if there is an issue within your team that may hinder your success.

**Guidelines for Teamwork**

To be successful with this project, there are some roles that must be filled on each team:

- Builder
- Programmer
- Robot Tester
- Scheduler
- Report Writer/Organizer

Depending on your skill set, you may be the lead team member or a supporting team member for the lead in one or more of these roles. No one person can accomplish this project on their own, but you may have to assume more than one role to get the project done.

Assess these possible roles within your team and find a place where your skills fit. When you are not actively performing your role, offer assistance and support to the team member(s) that are working on their portion of the project. If there is an imbalance of skill sets within your team, you may have to assume a role that is outside of your comfort zone. This is okay. Some people are natural leaders. Some are not. Put forth your best effort and lean on your teammates for help if you get stuck.

A good team dynamic is vital to the success of your robot. Here are some key skills for an effective team with a healthy team dynamic:

- Each team member is responsible and held accountable
- Able to give and receive constructive feedback
- Problem solving and strategy
- Time management and organization
- Open dialogue especially when brainstorming and problem solving – freedom to share all ideas without repercussion
- Respect for others
- Support of others

As instructors we believe that enthusiastic participation by your team will lead to the ultimate success of your final design. We wish you the very best of luck. Remember skill, ingenuity and honest effort are your best allies!