# ME 433 – Semester Project V2 (Updated 1/21/2024)

There are some key topics that everyone in ME 433 should learn about. But most students in this class also have niche topics that they are interested in. These are topics that we either don’t have time to cover or wouldn’t be of interest/benefit for most of the class.

To leave space for exploring these topics we are going to have a semester project. These can be done either alone, or in self-selected groups (limit size to 4 people or less). The class will be able to pitch ideas for projects before choosing theirs.

## Deliverables

I would like each group to put together a set of slides that gives a summary that might include something like:

* Reasons why they chose the topic
* How they gathered information about the topic
* Summary of what they learned (background, and current trends)
* What should we as engineers and members of society do with this information?

Possible Projects

1. Locate an inexpensive engine to disassemble. Acquire a service manual for the engine. During disassembly, make measurements of important wear items that you would use to determine the health of the engine, and what would need to be done to bring it back to a healthy/usable state.
2. Locate an even less expensive engine than Option 1 – due to some sort of engine failure. During disassembly determine what piece(s) broke. Use your detective skills (and ME 433 reasoning) to determine why the piece(s) failed. Come up with your best guess at what caused the conditions that caused the failure.
3. Work with Dr. Dan to select and acquire engine simulation software. Build and validate a virtual engine, then choose a set of studies to explore (camshaft profile, fuel changes, exhaust system changes, intake changes, cylinder head changes, etc.). Perform a series of simulations and organize the data in a way that will show trends and allow you do make a design recommendation.
4. Start the groundwork for designing a new engine. In particular, an externally scavenged uniflow direct injection two-stroke engine designed to make ~100 peak horsepower. This project should help answer questions about general engine geometry, exhaust port location and size, intake valving, and the type and size of the forced induction unit. Depending on how far the team gets there could be CAD modeling, and/or software simulation.
5. Create a robust interactive display showing how a rotary (Wankel) engine works. This could be done using a combination of actual engine pieces, 3D printed pieces, and laser cut pieces. It should allow the user to turn the eccentric shaft (either by hand or with variable speed motor) and see the rotor movement. Bonus for having lighting effects to show the intake, compression, combustion, expansion, and exhaust processes.
6. Design a drivetrain swap. For this project you will need to pick a vehicle platform, and choose an alternative drivetrain to install. As part of this you will need to address (at a minimum):
   1. Physical fitment (modifications necessary, and where to locate the components)
   2. All the interactions that were severed (power transmission, fuel system, intake and exhaust systems, engine accessories, cooling system, etc.)
   3. Engine control system, and integration with existing chassis communication/sensors.
   4. Subsystems that may need notable changes (cooling, fuel, etc.)
7. Create an interactive (cutaway) of a four-stroke reciprocating piston engine. This should be somewhat portable so that it could be brought to a class where students could learn about features and components of a modern engine. Some existing Arctic Cat engine(s) may be available as a starting point.
8. Design and create an engine management simulation bench. You might start with something like a [JimStim](http://www.jbperf.com/JimStim/), and design the housing, power supply, and short write-up on how to use this to create a set of electrical sensor inputs that could allow for bench testing of a programmable ECU. If the team makes lots of progress, a programmable ECU could be integrated for testing.
9. Research an engine subsystem that has seen some significant changes in the last 10 years. Figure out why this system is being updated, current technology/hardware being used to explore, and where this is headed in the future. Potential topics include:
   1. Hydrogen fuel (engine changes, or infrastructure changes)
   2. Real-time altering of camshaft profiles
   3. Discrete control of intake and exhaust valves
   4. Direct injection
   5. HCCI diesel
   6. HCCI gasoline
10. Researching current trends in hybrid vehicle design. How to size the assist? How to size the energy storage? Implications on fuel economy and electrical infrastructure.
11. Explore the world of differentials. Compile an exhaustive set of the types of differential (both for axles and center differentials in AWD systems). Explain how each of them work, and their characteristics in terms of torque split, and torque flow. Bonus for coming up with a demonstration of some sort.
12. Flow bench testing of cylinder heads. We have a SuperFlow flowbench (Model SF-300, that may need some maintenance/repair). Acquire a cylinder head (Dr. Dan can help with this). Acquire a manual for the flow bench. Make any necessary adapters/fixtures to perform some flow tests on a cylinder head. You should make an abbreviated ‘Quick Setup Guide’ for future students that takes them through the setup, instrumentation calibration, data collection, and analysis. Bonus: Test a few ports on the head, then modify one (porting with a die grinder, or a multi-angle valve job) to see how that changes the flow numbers.
13. Intentionally run an engine out of oil and/or coolant. Or diesel fuel in a gasoline engine. Or gasoline in a diesel engine.
14. Bottom end rebuild on existing engine
15. Honda Trail engine (disassemble, measure, refresh)  
    (put it in a go-cart, but don’t tell UI Risk Management)