ENGPHYS 4A06
Engineering Physics Design and Synthesis Project
Undergraduate Studies
Fall/Winter 2021/22
Course Outline

Current as of Wed 2021-08-18 13:54:09; see the course Forum for the most up-to-date version of this document

CALENDAR/COURSE DESCRIPTION

Engineering design capstone project synthesizing undergraduate Engineering Physics knowledge to select a meaningful real-world problem, and engineer a solution by mathematically modelling the impact of design decisions and implementing them physically as part of an engineering team.
Two labs (three hours each), one capstone project; both terms

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): Registration in the final level of an Engineering Physics program
Antirequisite(s): IBEHS 5P06

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. Matt Minnick
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Office Hours:
All the time asynchronously via the course forum
Live via course forum during class time
Use the forum! :-)

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

See the course forum for up-to-date TA information

LAB TECHNICIAN

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COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

Course Forum: Microsoft Teams

COURSE INTENDED LEARNING OUTCOMES

By the end of 4A06 you will be able to:

1. **Link your undergrad theoretical knowledge to the real world** and **apply it to CDIO** (conceive, design, implement, and operate) **a physical device through an engineering design process**, including:
    a. Finding a real-world problem and conceiving of a solution to it, as well as the specifications required by that solution,

   b. Designing your solution through mathematical/physical modelling and incorporating engineering design principles,
   c. Implementing your design through iterations and rigorous testing, and
   d. Operating a device that solves the problem at the required specifications.
2. Work effectively in a team engineering work environment, including:
   a. Demonstrating commitment to your team's objectives through punctuality, attendance, accountability, and positive engagement with the project,
   b. Completing individual and team deliverables within both external and internal time constraints,
   c. Giving constructive team member feedback,
   d. Using team member feedback about yourself to improve, and
   e. Fostering a healthy working environment with your team.
3. Communicate information about your inventions in a modern engineering world, including
   a. In technical reports which document your engineering design process (PSRs and technical reports),
   b. In technical seminars (live demos),
   c. In a tradeshow format (expo),
   d. Via social media (creating a YouTube video presentations), and
   e. To yourself and a mentor via reflection on personal performance and skill development.

In order to achieve maximum success, you are encouraged to become a person who takes pride in knowing things and takes the initiative to learn things even when no one tells you to.

MATERIALS AND FEES

As-needed for development of your specific project. For standard projects up to $650 of department reimbursement funding is available for supplies per group. This is only available at the end of the course (i.e., in April), and only with presentation of receipts (so please keep your receipts!) Interested groups may optionally select more ambitious projects than this allows and in those cases are especially encouraged to work with a client who can provide extra reimbursement funds and/or enter design competitions to help fund their project.

COURSE FORMAT AND EXPECTATIONS

Students will work as engineering teams of 3-5 (ideally 4) with their classmates on a project of their choosing that satisfies a client need. The client could be a professor looking for equipment or tools for their research lab, an industry member, a community member, or a hypothetical client (allowing teams to pursue more entrepreneurial or personal interest engineering design projects).

Finally, these deliverables are combined into a final report and video presentation to be delivered to independent industry judges at the final expo.

Structurally, this course is run through a forum rather than a live classroom. To ensure success, you'll need to
1. review all information posted publicly on the forum, including answers and feedback given to other students,
2. regularly check the forum in case any new information is posted, and
3. participate in the forum yourself by posting & answering questions, providing tips for classmates, etc.
These actions, along with attending during the scheduled class times and meeting times for coaching and progress meetings, are essential to stay informed of important course information and create the best learning community possible.

PROJECT DELIVERABLES:

Report

Design is an iterative process. The following lists the sections of the final report, but you will submit earlier drafts and parts of this earlier on in the course, revising, updating, and building on them as you iterate on your design throughout the year.

Report Sections:

1. Abstract:
    a. A One-Page Summary that lists, in a format accessible to someone unfamiliar with your project like an industry judge:
        i. What problem were you trying to solve? (i.e., What was your project design goal? What were the target specs of your final device?)
        ii. How close did you come to a solution with your working model?
        iii. What was the engineering work you did to achieve it?
2. Project Proposal (This section is all you'll submit for the Shark Den report, and for both "Proposal" deliverables.)
    a. Summary: A project proposal is a document that communicates
        i. What you're going to do (but not how)
        ii. Why you're going to do it (who wants this and why do they want it?)
        iii. How you'll know whether you're successful (and be able to prove it)
        iv. The engineering design work you're individually committed to do (in order to help make it happen).
    b. Sections:
        i. Problem statement: from general aspect provided by client to specific aspect that group will focus on
            1. Tip: Make sure to spend a lot of time *framing* the problem before solving it
            2. Tip: Have a specific (even if imagined) client in mind; the more clearly you can understand the client the more you'll be able to frame why they really want this to write a believable net value function and compare possible solutions.
        ii. General solution description:
            1. Write out what characteristics (i.e., hard and soft requirements, priorities between different requirements) a solution would need in order to be a solution
            2. Write an equation expressing the perceived "net value" of a potential solution that allows you to honestly compare alternatives and quantify which of possible trade-offs are better (e.g., suppose solution B is 50% lighter but 2x the cost; is that better?)
            3. Tips: Check that this net value fn. satisfies
                a. edge cases (does it correctly dismiss crazy ideas that definitely won't work?),
                b. scaling (does it reflect the real change in value from a given change in a performance metric?),
                c. reality checks (does it *feel* right?)
                d. Be willing to estimate things when you don't know them, just acknowledge the estimate and do focused research to help resolve it when possible / necessary.

e. Be willing to return to re-framing the problem if you need more information.

iii. Existing and potential solutions and how they rank up in the merit function
1. Tip: Should include an honest comparison of existing ones with ones you came up with. Be design *fluid* - willing to change to a different idea if your evaluations of if show another is better.
2. Tip: Later on, you will find new information that has you adjust info you gave here and in many other sections. Acknowledge the learning when that happens, and update in light of new experience; keep enough of the old info to show the iteration but organize so it's not confusing to read through for a newcomer to your project.

iv. Proposed project for next revision
1. Based on the info from the previous section, select your current **proposed design solution** to explore at this stage for the next revision.
2. Fully imagine the **final state** of the project using this solution, down to the level of proposing operating instructions to give a clear picture of the final device (but NOT explaining how it works internally yet; that's what you'll design later); instead, specify specs that are observable to the end-user (i.e., factored into the net value function) and **instructions for how you'd test the finished device** to determine whether it has achieved these specs (and help explain what the specs mean).
3. **Important:** Propose the **engineering design work** you'll do
a. What **design decisions** will you each individually address by making a **mathematical model** and possibly **valid experiments** to aid it?
4. Propose your target **working model to demo for the next revision:** what the group plans to physically build (or simulate) as a proof of concept of this device (or part of it). You don't need to actually complete the device by the end of the course, as long as what you do build helps justify the engineering design work you did and makes meaningful progress towards reaching a final design at your design problem.

c. You need to get approval that your project makes sense to your client, and also get approval from your TA & instructor. We may reject and need you to modify a project for a variety of reasons, including but not limited to:
i. the work breakdown is unfair and does not give enough real engineering design responsibility to each team-member,
ii. the project description is too vague,
iii. the project has major safety issues,
iv. the project goal is infeasible for capstone given the timeframe and budget available

3. Engineering Design Work (This section is all you'll submit for the Rev 0 and Rev 1 Engineering Design Work deliverables)
a. Individual sections are needed for each team-member, and should document the design work they each did. Your mark for the two dedicated Engineering Design Work submissions will be based on your own sections only.
b. Engineering Design = Mathematical modelling to make design decisions
i. A **design decision** is a decision that impacts your design (i.e., proposed project solution)
1. e.g., "How thick does this bracket need to be?" (minimum for safety)
2. "What is the optimal thickness of this bracket?" (better - incorporates safety, but also cost, durability, portability, etc.)

3. "Do we need to switch this bracket to a different design or is the one we have OK?" (though not as exciting for deciding on an optimal design, a check like this and decision not to change is still a decision)
4. "Which of these potential commercially available brackets would be optimal for our design?" (useful, and reflects reality, as long as you actually follow through on that decision!)

ii. An **engineering design decision** is a design decision made using **mathematical modelling**
iii. **Mathematical modelling** *is*:
1. taking any problem you want to solve,
2. using physics to transform it into some kind of mathematical representation,
3. solving the math (using a computer or any method), and finally
4. using physics to interpret what the result means.
iv. Only do mathematical modelling that's *relevant*, i.e., that helps you make some design *decision*; this can be to decide something that optimizes your merit function, or [for a complicated enough thing] even to figure out how to do it.
v. Mathematical modelling is not something you do *before* you design, it's *how* you design; it's the method you use to make engineering design decisions.
vi. This is *challenging*! The ability to take all that undergrad math and physics and actually apply that to make real design decisions is what makes an engineer an engineer. It's important that your conclusions are **valid**; often times it's impossible to *completely* get the result from analytical work. This doesn't mean you don't do analytical work, and it doesn't mean you trick yourself into believing analytical work when it's not justified. Instead, it means you do the mathematical modelling as best as you can to understand the space and predicted scaling of the results, and set up **valid experiments** to determine what you need to know to improve on the model and get the data you need to make design decisions.

c. You may also use mathematical modelling at earlier or later stages in the project, and can and should collect your writeups of those here as well;
i. e.g., for ideation and proposal writing to help determine whether a proposed design is scientifically feasible. This helps in the decision of which solution to choose for the problem to begin with
ii. e.g., for troubleshooting. When parts of the working model seem to not be working, you may model aspects of how they are working to understand

d. Not every decision you make necessarily *needs* to be made with such a thorough approach; sometimes you can just buy an LED, and shouldn't feel the need to reinvent the wheel. You just need to do *enough* rigorous engineering design work *somewhere* for a reasonable capstone course contribution for you personally, and after that *may* continue to optimize using engineering design work like this if you really want the completely optimized solution. This is why:
i. it's important to pick a project that has enough *potential* for meaningful engineering design, and
ii. it's OK if you aim higher and pick a project that has *more* potential opportunities for design than you *need* and just don't take advantage of all of them.

4. Assembly (manufacturing) History and Instructions
a. Summarize the final version of the working model for this revision.
i. Sample Contents:
1. Parts list;

2. machining drawings with all tolerances for manufactured components
3. Code to upload and instructions for doing so

ii. Where decisions for what parts to use or how to build something were based on engineering design, point them out and refer to the appropriate part of your engineering design work section.
iii. Where decisions were instead made for non-engineering-justified reasons (followed a tutorial, took advice of someone, just chose it arbitrarily, used it because it was available, etc.), acknowledge what those reasons were as well - you may need/want to revisit these in the future if they turn out to lead to problems and acknowledging this will help!

b. Document the approach to get to this working model past the initial design stage, especially targeted troubleshooting you took to get it working

5. Testing
   a. Document testing of your working model and specs that it achieves.
   b. Compare with anticipated / target specs.
   c. Discuss potential reasons for discrepancies
6. Design Brief: Summary Reflection
   a. Summarize the major achievements your group made over the project.
      i. What did you design and how?
      ii. What did you build and test, and what were the results?
      iii. What iterations did you make, and what can you conclude about the design solution going forward at this time?
      iv. Where did you apply best practices of design, and learn in the process?

Marks on report:
1. Clarity: 10%
2. Completeness: 10%
3. Engineering work quality: 30%
4. Documented Performance: 10%
5. Documented Use of Informed Design Best Practices: 20%
6. Presentation & Formatting: 10%
7. Overall Impression: 10%

Video

Your video should efficiently and professionally communicate:
1. ~1 minute: the background of the need for your project (i.e., who your client is and why they need this),
2. ~1 minute: what your proposed solution is, including its specs

after Shark Den (i.e., at the Demo & Expo Presentations), your video will also include the following:
3. ~1.5 minute: engineering design work achievements your team made
4. ~1 minute: testing procedure & results
5. ~0.5 minute: path forward and future of the project

Marking Rubric for Video:
1. Content: 60%, equally weighted between:
   a. Objective Clarity & Motivation - 20%,
   b. [after Shark Den] Engineering Design Quality & Clarity - 20%

   c. [after Shark Den] Performance Demonstrated - 20%
2. Overall Impression: 40%,

Demo [Presentations]

Pitch Presentations (e.g., the Practice Pitch Presentations and Shark Den) should start with showing the video, then proceed directly to Q&A (you don't need to re-deliver the presentation or demonstrate anything live). Have key info ready on a slide to discuss. You will also want support material ready on slides to deal with questions, especially about existing solutions, components, and technologies / strategies you might use.

Mark rubric for Pitch Presentations are:

1. Clarity of the Problem Statement: 25%
2. Clarity & Believability of Justification for Proposed Solution: 35%
   a. (this requires framing and explaining the problem well enough, justifying the criteria for assessing solutions, and believably balancing benefits & trade offs to make the decision of what to investigate as a proposed solution)
3. Appropriateness for a Capstone Project: 20%
4. Professionalism: 20%

Rev 0, Rev 1, and Expo Demos: should show the updated video, then proceed to demonstrating live the current performance of your working model. Marks for these demos are:

1. Quality of clearly demonstrated performance ***and*** engineering work 90%,
   a. Good performance of the working model can't replace good engineering work, but good engineering work may (in some situations) be able to make up for bad performance.
   b. It's not as if this 90% is a specific split between performance and engineering work, it's a case-by-case evaluation; if your device doesn't work but you can completely understand what went wrong, why it did, and how you would fix it at a deep level this can be just as valuable (and much more valuable than having it work but not understanding why).
2. Professionalism 10%,

COURSE SCHEDULE

The schedule explanation includes only rough timing details; see the Table for details of those.

SCHEDULE QUALITATIVE EXPLANATION

1. First 2 weeks: explain course deliverables and logistics, mini quizzes & assignments on it
   a. These weeks we'll use up all of the time for both sessions. You should expect to be present, and have quizzes to test your mastery of the content in the course and design principles.
   b. You'll practice *marking* (or at least critiquing & giving feedback to) things you'll need to submit later.
   c. You'll see demos of practice pitches and get to grill the instructor on it; we'll go over what went wrong, go over what we should avoid.
2. 2 weeks: practice pitches & proposals
   a. First, you'll complete a proposal and perform a pitch individually. Then you'll form groups and do a group pitch on a new idea, or possibly one that one of you pitched individually (or that someone now in another group did, with their permission).
   b. Prior to each pitch, you'll have a meeting with TA & instructor (~30 min with TA pitching problem statement for ideas, getting instructor input for last 10 of these)

3. 1 week: Shark Den with report & video
    a. Shark Den is a formal project pitch to the course admin as well as other professors and industry guests (who will likely return as judges at Expo and possibly be clients for you throughout the year)
    b. You can pitch one of the ideas you used from a practice pitch, an entirely new idea, or even an idea another group pitched that they're not going to use.
4. After Shark Den: Project Proposal due
    a. Also presents what you'll do for **Rev 0** ("proof of concept" design & demo)
    b. Rev 0 needs you to explain which things specifically you'll demonstrate at the first demo as your performance metric(s) to show that your proof of concept design was successful.
        i. Not in terms of laying out the marks, but in terms of laying out the goals and their priorities in light of the full project.
5. After the Shark Den, the class will continue to regularly meet all together only once per week for design exercises & refreshers, guest lectures, and town hall style Q&A; these will take place at 1430 on Tuesdays. In addition to this, you'll have coaching meetings and PSR meetings..
6. [Coaching weekly meetings]
    a. On Friday Lab Days, there's a 10+ minute meeting per person with the TA (and sometimes instructor / Labtech) where you demo working through the process of whatever you're working on for project success and get coaching towards it.
7. [PSRs start (i.e., weekly project status reports)] PSRs occur on Tuesday Lab Days, and are
    a. 80% based on how on-track you demonstrate you are relative to your schedule
        i. Can only update the broad milestones on the schedule on the first PSR of each month. Whether or not you update it, you must reflect on whether the timeline you're proposing is still viable.
        ii. No updated clear schedule = 0%; using a Gantt chart or similar format is optional; key is that the schedule is readable and up-to-date.
        iii. 20% off per week behind the group is, but can recover up to half of the lost marks with believable clear and specific plan to get back on-track.
    b. 20% based on professionalism in the PSR
    c. Every 2nd PSR is also a meeting with the instructor in term 1, and every 3rd in term 2
    d. Part of the PSR is giving a bi-weekly email to TA & instructor giving feedback on what each group-member has done. Not doing this could make you behind compared to your group.
    e. Structurally, the PSR contains:
        i. bullet point summary of progress
        ii. reflection on past week
        iii. timeline update
        iv. bullet point summary of goals for next week to progress (or get back on-track)
        v. [if first PSR of month] update schedule
8. November end: Rev 0 Engineering Design work due
9. January week 4: Rev 0 Demo, video, & report
    a. Including assembly instructions & testing results; paves the way for Rev 1
10. Feb week 1: Rev 1 Proposal due
11. After reading week: Rev 1 Engineering Design work
12. March week 4: Rev 1 Demo, video, & report
13. April: Expo (live demo, video, and report)

SCHEDULE TABLE

Date	Homework Due	Class Topic
Tue 7 Sep	Design Quiz	Intro to capstone, eng design, and mathematical modelling
Fri 10 Sep	Design Quiz	Problem Framing and Proposal Writing
Tue 14 Sep	Design Quiz	Project Pitches; Solutions
Fri 17 Sep	Design Quiz	Reflection, troubleshooting, and design documentation
Tue 21 Sep	S1, Project Ideas	Soft-pitch to TA / instructor, individually
Fri 24 Sep	Practice Pitch 1	Practice pitch to class, individually
Tue 28 Sep	Project Ideas	Get feedback on pitches
Fri 1 Oct	Project Ideas, Groups	Form Groups - Get feedback on ideas for Practice Pitch 2
Tue 5 Oct	Practice Pitch 2	Practice pitch to class in groups; with video
Fri 8 Oct	Work for coaching	Reflect on pitches, plan for shark den & proposal
Mon 11 Oct – *Fri 15 Oct*	***Midterm Recess***	
Tue 19 Oct	Shark Den	
Fri 22 Oct	Refined Ideas	Reflect on shark den, tune project proposal
Tue 26 Oct	Rev 0 Proposal	
Fri 29 Oct	Work for coaching	Feedback on Proposal
Tue 2 Nov	PSR	
Fri 5 Nov	Work for coaching	
Tue 9 Nov	PSR	
Fri 12 Nov	Work for coaching	
Tue 16 Nov	PSR	
Fri 19 Nov	Work for coaching	
Tue 23 Nov	PSR	
Fri 26 Nov	Work for coaching	
Tue 30 Nov	Rev 0 Eng Design	
Fri 3 Dec	Work for coaching	Feedback on Eng Design
Tue 7 Dec	PSR (include plans for break)	
Wed 8 Dec – *Sun 9 Jan*	***Exams & Winter Break***	
Tue 11 Jan	S2+PSR (include progress over break)	
Fri 14 Jan	Work for coaching	
Tue 18 Jan	PSR	

Fri 21 Jan	Work for coaching	Plan for Demo
Tue 25 Jan	Rev 0 Demo	
Fri 28 Jan	Work for coaching	Feedback on Demo; plan for Proposal
Tue 1 Feb	Rev 1 Proposal	
Fri 4 Feb	Work for coaching	Feedback on Proposal
Tue 8 Feb	PSR	
Fri 11 Feb	Work for coaching	
Tue 15 Feb	PSR	
Fri 18 Feb	Work for coaching	
Mon 21 Feb- *Fri 25 Feb*	***Midterm Recess***	
Tue 1 Mar	PSR	
Fri 4 Mar	Work for coaching	
Tue 8 Mar	Rev 1 Eng Design	
Fri 11 Mar	Work for coaching	Feedback on Eng Design
Tue 15 Mar	PSR	
Fri 18 Mar	Work for coaching	
Tue 22 Mar	PSR	
Fri 25 Mar	Work for coaching	Plan for Demo
Tue 29 Mar	Rev 1 Demo	
Fri 1 Apr	Work for coaching	Feedback on Demo; plan for Expo
Tue 5 Apr	PSR	
Fri 8 Apr	Work for coaching	Plan for Expo
Tue 12 Apr	Expo	
Fri 15 Apr	Final Reflection	

Some days also have self-reflection surveys (S1, S2, and S3) as separate deliverables; these are a chance to reflect on your current progress towards the course Intended Learning Outcomes (ILO)s and Canadian Engineering Accreditation Board (CEAB)'s Graduate Attributes, and goal-set to maximize your success in achieving positive outcomes from this course. This kind of guided reflection as part of experiential learning courses is seen as essential by Ontario government requirements, CEAB requirements, and research on what enhances your learning, so to encourage you to do them, these are incorporated into the regular schedule-driven grading deliverables. These will be announced in the forum when they become available; see the course schedule for details of when these are due.

ASSESSMENT

Grade breakdown is as follows:

Assessment Item	Weight	Subcomponent weight
Design & Logistics Intro (total)	2.0%	
Reflections (total)	3.0%	
PSRs (total)	13%	
Practice Pitches (Total)	2%	
Shark Den	6%	
SD Pres		3.00%
SD Video		1.20%
SD Rept		1.80%
Rev 0 Proposal	3.0%	
Rev 0 Eng Des	6%	
Rev 0 Demo vid rept	12%	
0Demo		6.00%
0Vid		2.40%
0Rept		3.60%
Rev 1 Proposal	4.0%	
Rev 1 Eng Des	8%	
Rev 1 Demo vid rept	16%	
1Demo		8.00%
1Vid		3.20%
1Rept		4.80%
Expo Demo vid rept	25%	
ExDemo		12.50%
ExVid		5.00%
ExRept		7.50%
Expo Industry Judging	0%	
Bonuses	Special+	
Grand Total	100.0%	

EXPO INDUSTRY JUDGING RUBRIC

At Expo, judges will assess your group's expo deliverables (report, video, presentation & questions) using the following metrics (subject to change):

Originality
1. Originality: Novelty of the project object (vs. review of the known or existing). 1-5
2. What is the significance of the portion of the project designed/constructed by the students as opposed to purchased/acquired? 1-5

[Optional] Comments: _____

Presentation
1. Organization: Clear and logical flow of project overview. Poster should address Introduction, analysis, design, testing, and conclusion. 1-5
2. Knowledge of Subject: Background knowledge, clarity of explanations, clarity and brevity of answers to questions. 1-5
3. Visual Impact: Effectiveness of the visual presentation of project. 1-5
4. Illustrative Material: Demonstration of results, choice and perfection of illustrative material. 1-5
5. Clarity of Project: Clarity, grammar and spelling, match between the poster and audience. 1-5
[Optional] Comments: _____

Technical Content
1. Technical Level: Project's overall complexity – Industrial technology or University level (vs. Technical College or Technical School level). 1-5
2. Analytical Competence: Quantitative approach, use of calculus, numerical calculations, plotting and graphing. 1-5
3. Design Complexity: Evaluate the depth and breadth of design abstraction and creativity of solution. 1-5
4. Functionality: Results of testing, reliability, portability, etc. 1-5
[Optional] Comments: _____

Independent Learning
Be able to critically evaluate and apply knowledge, methods and skills procured through self directed and self identified sources, including those that lie outside the nominal course curriculum.
Below Expectations (1) – Students made no independent effort to acquire significant outside skills/knowledge.
Marginal (2) – Students were able to identify appropriate sources for information, but did not acquire or apply them
Meets Expectations (3) – Students acquired a significant skill in one area outside normal curriculum and identified appropriate sources.
Exceeds Expectations (4) – Students acquired more than one significant skill in more than one area independently.
[Optional] Comments: _____

In addition to these individual metrics, judges will also assign a grade based on this prompt:
Overall Impression
Considering all aspects (the importance and clarity of the project objective, the creativity, applicability, and success of the solution, and the quality and quantity of the engineering the team did to achieve it), rate the overall quality of this engineering capstone project as-presented
__/100
[Optional] Comments: _____

BONUS DELIVERABLES

Some optional things you could consider in the course are big boosts to your portfolio for the purpose of getting a job, and definitely good ways to make yourself score better with the industry judges at the end of the year. These include (but aren't limited to):

1. Being a finalist or winner of external design competitions (e.g., MEC / OEC / CEC, The Forge's Pitch Competition & Student Start-up Competition, Lion's Lair & Python's Pit, etc.)
2. Writing and Publishing Journal Articles of optimizations / extensive simulations etc. in the course of your design,
3. Filing Provisional Patents
4. Securing Industry Funding Partnerships / Other Investors for your project

Besides these intangible benefits of making your project look a lot better at the end of the year (and as you move beyond and apply for jobs), and the tangible benefits of these (in terms of prize / start-up money, patents, etc.), work done towards these above and beyond the course deliverables can in some cases add ***reweight bonus marks*** - talk to the course admin for details.

ACCREDITATION LEARNING OUTCOMES

The Learning Outcomes defined in this section are measured for Accreditation purposes only and will not be directly taken into consideration in determining a student's grade in the course.

Outcomes	Indicators
Applies appropriate knowledge of math in engineering work	01.1 - Competence in Mathematics
Applies appropriate knowledge of natural science foundations in engineering work	01.2 - Competence in Natural Sciences
Applies appropriate knowledge of engineering science foundations in engineering work	01.3 - Competence in Engineering Fundamentals
Applies appropriate knowledge of specific Eng Phys foundations in engineering work	01.4 - Competence in Specialized Engineering Knowledge
Proposes proper merit functions, specifying constraints in projects	02.1 - Demonstrates an ability to identify reasonable assumptions (including identification of uncertainties and imprecise information) that could or should be made before a solution path is proposed.
Mathematically models solutions in the project in a way that reflects reality	03.2 - Selects appropriate model and methods and identifies assumptions and constraints.
Iterates on design process correcting assumptions to converge on a solution in reality	04.2 - Recognizes and follows engineering design principles including appropriate consideration of environmental, social and economic aspects as well as health and safety issues.
Specifies creative solutions for both choice of and solution to projects	04.3 - Proposes solutions to open-ended problems.
Follows health and safety procedures through design and with its solution	04.5 - Includes appropriate health and safety considerations
Demonstrates a knowledge of appropriate codes and standards applicable	04.6 - Determines and employs applicable standards and codes of practice.
Uses advanced design tools to solve engineering problems of relevance	05.3 - Creates, adapts, modifies and extends tools and techniques as appropriate to solve problems.
Maintains good working conditions in the team throughout the design project	06.2 - Develops and implements processes and methodologies to manage the effectiveness of a team

	both in terms of the quality of the work produced by the team as well as the inter-personal relationships within the team.
Is able to efficiently and professionally communicate with client throughout the process	07.3 - Constructs effective oral or written arguments as appropriate to the circumstances
Keeps up with deadlines and budgets	11.2 - Plans and effectively manages time, resources, and scope
Extends knowledge by using undergrad knowledge as not an end, but a springboard on which to look beyond and seek new information as appropriate	12.1 - Critically evaluates and applies knowledge, methods and skills procured through self directed and self identified sources, including those that lie outside the nominal course curriculum.

For more information on Accreditation, please visit: https://www.engineerscanada.ca

EQUITY, DIVERSITY, AND INCLUSION

Every registered student belongs in this course. Diversity of backgrounds and experiences is expected and welcome. You can expect your Instructor to be respectful of this diversity in all aspects of the course, and the same is expected of you.

The Department of Engineering Physics is committed to creating an environment in which students of all genders, cultures, ethnicities, races, sexual orientations, abilities, and socioeconomic backgrounds have equal access to education and are welcomed and treated fairly. If you have any concerns regarding inclusion in our Department, in particular if you or one of your peers is experiencing harassment or discrimination, you are encouraged to contact the Chair, Associate Undergraduate Chair, Academic Advisor or to contact the Equity and Inclusion Office.

PHYSICAL AND MENTAL HEALTH

For a list of McMaster University's resources, please refer to the Student Wellness Centre.

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the *Academic Integrity Policy*, located at https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/

The following illustrates only three forms of academic dishonesty:

1. plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. improper collaboration in group work.
3. copying or using unauthorized aids in tests and examinations.

COURSES WITH AN ON-LINE ELEMENT

McMaster is committed to an inclusive and respectful community. These principles and expectations extend to online activities including electronic chat groups, video calls and other learning platforms.

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's *Academic Accommodation of Students with Disabilities* policy.

COURSE POLICY ON MISSED WORK, EXTENSIONS, AND LATE PENALTIES

It is the students' responsibility to regularly check the course forum (MS Teams) for updates and announcements. Under normal circumstances, missed deadlines are assigned a late penalty by multiplying the grade they would otherwise receive by a fraction that decreases linearly from 100% to 0% over the first 10 hours past the deadline.

SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

1. Relief for missed academic work worth less than 25% of the final grade resulting from medical or personal situations lasting up to three calendar days:
   - Use the McMaster Student Absence Form (MSAF) on-line self-reporting tool. No further documentation is required.

- Students may submit requests for relief using the MSAF once per term.
- An automated email will be sent to the course instructor, who will determine the appropriate relief. Students must immediately follow up with their instructors. Failure to do so may negate the opportunity for relief.
    a. Relief in this course means an extension on the due date of the deliverable(s) by 3 calendar days.
- The MSAF cannot be used to meet a religious obligation or to celebrate an important religious holiday.
- The MSAF cannot be used for academic work that has already been completed or attempted.
- An MSAF applies only to work that is due within the period for which the MSAF applies, i.e. the 3-day period that is specified in the MSAF; however, all work due in that period can be covered by one MSAF.
- The MSAF cannot be used to apply for relief for any final examination or its equivalent. See *Petitions for Special Consideration* above.

2. For medical or personal situations lasting more than three calendar days, and/or for missed academic work worth 25% or more of the final grade, and/or for any request for relief in a term where the MSAF has been used previously in that term:
    - Students must report to their Faculty Office to discuss their situation and will be required to provide appropriate **supporting documentation**.
    - If warranted, the Faculty Office will approve the absence, and the instructor will determine appropriate relief.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office ***normally within 10 working days*** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.