

**ENGPYYS 2P04  
Computational Mechanics  
Undergraduate Studies  
Fall/Winter 2020/21  
Course Outline**

Current as of Tue 2020-09-01 07:01:55; see the course Forum for the most up-to-date version of this document

**CALENDAR/COURSE DESCRIPTION**

Classical mechanics topics including coupled oscillators, elasticity, force and bending moment diagrams, tensors, Voigt notation, flexure, and beam resonance explored computationally using finite element method and computer algebra system software.

Three lectures, one lab (two hours each); first term

**PRE-REQUISITES AND ANTI-REQUISITES**

Prerequisite(s): PHYSICS 1D03; and credit or registration in MATH 2Z03

Antirequisite(s): None

**INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION**

Dr. Matt Minnick  
BSB/B106  
[minnick@mcmaster.ca](mailto:minnick@mcmaster.ca)  
ext. 24546

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**

TA#1  
TA#2  
TA#3

**COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION**

Course Forum: Microsoft Teams

**COURSE INTENDED LEARNING OUTCOMES**

Upon successful completion of the course, you will be able to:

1. Explain a variety of core principles in mechanics, both statics and dynamics
2. Use a computer algebra system (Maple) to solve a variety of physics and math problems
3. Use a FEM solver (FlexPDE) to solve partial differential equations on complex geometries

**MATERIALS AND FEES**

COMPUTER:

Students should have a desktop or laptop capable of simultaneously running FlexPDE, Maple, and Microsoft Word (Windows machines are recommended, price point of \$300 or up should be fine). You will be required to use this for all deliverables in the course.

SOFTWARE:

FlexPDE Student Version (free online), Maple (Version 15 or higher), and MS Word (2007 or newer)

REFERENCE TEXTS:

-[Optional] Physics for Scientists and Engineers, Brooks Cole, Serway & Jewett, 978-1133947271 (same as first year)

-[Required] Course notes (free online)

<b>COURSE FORMAT AND EXPECTATIONS</b>
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The course is organized as follows:

Resources:

- Lecture notes & examples (online)
- Worked Example Practice Problems (online)
- Course videos explaining the notes & some practice problems each week (on YouTube)
- The forum, where you can get help from me, the TAs, and each other

The course is divided into 11 content weeks focused on **prep work** (work that is primarily for you to learn the material for your own benefit) followed by 2 weeks of **portfolio work** (work that is something you'd keep to show off to a potential employer). [See the Course Schedule](#) in the next section. In that schedule, prep work are the H1.1, H1.2, H1.3, H2.1, etc. deliverables that occur most weeks while portfolio work are the P1, P2, etc. deliverables at the end of the course (there are also 3 reflection surveys S1, S2, and S3).

Except for the reflection surveys (S1, S2, S3) which are private (but not anonymous) via quizzes, you'll submit all your assignments (i.e., prep work H1.1, H1.2, etc. or portfolio work P1, P2, etc.) publically through the course forum. Feel free to look at other people's assignments to learn more and be proud of them for their work! The forum is also the primary place to ask and get answers to questions. I'll hang out on the forum during all class times and myself and the TAs will check it regularly besides that as well, plus you can get help from other students too.

Your timeline for regular content weeks is as follows:

Wednesday: working through notes, working through solution and neat thing learned

Friday during class time: finalize write-up if necessary; Q&A

Friday end of class time: HX.1 due

Friday lab time: working on HX.2; getting suggestions, writing up problem

Sunday evening: HX.2 due

Monday morning: HX.3 pairs assigned

Tuesday during class: finalize questions on HX.3, meeting with partner if necessary.

Tuesday evening: HX.3 due

HX.1 means watch the weeks' video(s), read its notes, etc. and write up a solution to a variation of one problem you made while working through it that shows off something you learned in the process; explain something great you learned. **Work on in-class Wednesday, due at end of class Friday.**

To prepare for HX.1:

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1. Watch and work through the week's videos, while reading & working through its notes
2. Try some of the practice problems with the help of the video
3. Try some of the problems on your own

Hand in: A variation on one of the problems this week (e.g., changing the question a bit and work through the solution, then comment on how the change affected it, whether this is expected and why; what does it mean?). Explain something great you learned in the process.

HX.2 means create a "totally" new (but related) practice problem you made yourself using this week's content for a classmate to try, and a solution write-up to it. You'll be partnered up and will have someone else do your problem, so need to make sure it's solvable (by submitting a solution as well!). **Work on in Friday's Lab time, hand in by Sunday evening.**

Hand in: a write up of the problem, and a writeup of your example solution to it.

HX.3 means solve someone else's HX.2, writing up a variation solution (not just their solution) or solution to a variation problem and what it means, and something neat you learned in the process. **Due by the end of the day on Tuesday. (work on Monday night and in-class on Tuesday)**

Hand in: the variation & solution write-up, commentary on the meaning of the solutions, and what you learned from it

The final design project (i.e., portfolio work P1) is to create and solve a major problem that shows off everything (or as much as you can) that you've learned in the course for showing off to potential employers. Make and solve a problem which is a challenge for you.

This has 5 deliverables:

- P1.1 Write a proposal of what you're planning to do **(Due by the end of Wednesday December 2nd)**
- P1.2 Submit feedback on your partner's proposal **(Due during the lab period on Friday December 4th)**
- P1.3 Submit a draft of your write-up of the project **(Due prior to class on Tuesday December 8th)**
- P1.4 Submit on someone else's draft, and **(Due by the end of Wednesday December 9th)**
- P1.5 Submit your final version. **(Due end of Friday December 18th)**

<b>COURSE SCHEDULE</b>
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<u>Date</u>	<u>Homework Due</u>	<u>Daily Activity</u>	<u>Week's Content</u>
Tue 8 Sep		Get course material, get software working, start watching the first week's videos and trying problems	Phys 1D with Maple & FlexPDE
Wed 9 Sep		Finish week 1's videos, write up H1.1	
Fri 11 Sep	H1.1+S1	Hand in S1, work on H1.2	
Sun 13 Sep	H1.2	Finish H1.2	
Tue 15 Sep	H1.3	Finish H1.3, start work on week 2	
Wed 16 Sep		Finish week 2's videos, work on H2.1	Harmonic Motion & Resonance
Fri 18 Sep	H2.1	work on H2.2	

<u>Date</u>	<u>Homework Due</u>	<u>Daily Activity</u>	<u>Week's Content</u>
Sun 20 Sep	H2.2	Finish H2.2	
Tue 22 Sep	H2.3	Finish H2.3, start work on week 3	
Wed 23 Sep		Finish week 3's videos, write up H3.1	Static Equilibrium
Fri 25 Sep	H3.1	Work on H3.2	
Sun 27 Sep	H3.2		
Tue 29 Sep	H3.3		
Wed 30 Sep		Finish week 4's videos, write up H4.1	Trusses, Machines, and Equivalent Loads
Fri 2 Oct	H4.1	Work on H4.2	
Sun 4 Oct	H4.2		
Tue 6 Oct	H4.3		
Wed 7 Oct		Finish week 5's videos, write up H5.1	Internal Forces and Moments
Fri 9 Oct	H5.1+S2	Work on H5.2 & do S2 reflection	
Sun 11 Oct			<b>Midterm Recess</b>
Tue 13 Oct			
Wed 14 Oct			
Fri 16 Oct			
Sun 18 Oct	H5.2		
Tue 20 Oct	H5.3		
Wed 21 Oct		Finish week 6's videos, write up H6.1	Normal Elasticity
Fri 23 Oct	H6.1	Work on H6.2	
Sun 25 Oct	H6.2		
Tue 27 Oct	H6.3		
Wed 28 Oct		Finish week 7's videos, write up H7.1	Shear Elasticity
Fri 30 Oct	H7.1	Work on H7.2	
Sun 1 Nov	H7.2		
Tue 3 Nov	H7.3		
Wed 4 Nov		Finish week 8's videos, write up H8.1	Flexural Elasticity: Beam Bending
Fri 6 Nov	H8.1	Work on H8.2	
Sun 8 Nov	H8.2	Think about portfolio project	
Tue 10 Nov	H8.3		
Wed 11 Nov		Finish week 9's videos, write up H9.1	Torsional Elasticity: Beam Twisting
Fri 13 Nov	H9.1	Work on H9.2	
Sun 15 Nov	H9.2	Think about portfolio project	
Tue 17 Nov	H9.3		
Wed 18 Nov		Finish week 10's videos, write up H10.1	Beam Resonance

Date	Homework Due	Daily Activity	Week's Content
Fri 20 Nov	H10.1	Work on H10.2	
Sun 22 Nov	H10.2	Think about portfolio project	
Tue 24 Nov	H10.3		
Wed 25 Nov		Finish week 11's videos, write up H11.1	General Elasticity: Crystals and Voigt Notation
Fri 27 Nov	H11.1	Work on H11.2	
Sun 29 Nov	H11.2	Think about portfolio project	
Tue 1 Dec	H11.3		
Wed 2 Dec	P1.1	Work on & submit project proposal (P1.1)	Final Portfolio Project
Fri 4 Dec	P1.2	Review partner's proposal, give feedback	
Sun 6 Dec		Work on project	
Tue 8 Dec	P1.3	Submit project draft	
Wed 9 Dec	P1.4	Review partner's draft, give feedback	
Fri 18 Dec	P1.5+S3	Submit final project & reflection survey	

#### ASSESSMENT

This course uses schedule-driven grading. You start at A++ (i.e., the fictitious McMaster '13') and lose one grade point (i.e., A++ → A+, A+ → A, etc.) with every "missed" deliverable, meaning that you either didn't submit anything, didn't submit it on time, or what you submitted was not a reasonable honest effort on your part.

**Exception 1:** problems happen. If you submit something late (except where given an extension by an MSAF) you can either take the grade reduction (it's not the end of the world!) or work to overcome what went wrong that time and make up for it in the future by being at least 3 times as early as you were late on each of the next 3 deliverables (the onus is on you to demonstrate this via appropriate screenshots etc. if you'd like to take advantage of this option).

**Exception 2:** You can't skip the final submission of the final project; it just counts as a "missed" deliverable and becomes due again 3 calendar days later again and again until you submit it.

**Exception 3:** I reserve the right to increase people's grade if they go above and beyond and submit truly outstanding work on a deliverable.

#### 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

**Can examine an engineering problem in mechanics and decide whether to optimally tackle it analytically, with a CAS like Maple, or with FEM like with FlexPDE**

05.1 - Evaluates and selects appropriate modern tools.

<b>Can use CAS and FEM solvers to solve mechanics problems computationally</b>	05.2 - Demonstrates an ability to use modern/state of the art tools.
<b>Can work with others to complete engineering work on time and communicate it digitally via professional documents in a forum</b>	06.1 - Manages time and processes effectively, prioritizing competing demands to achieve personal and team goals and objectives.

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](https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/), 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](mailto: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 webpage (ATL) and forum for updates and announcements. Under normal circumstances, missed deadlines correspond to a reduction in grade as per the assessment section.

#### 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.