

**Engineering Physics 2NE3**  
**Thermal Systems Design**  
Undergraduate Studies  
Fall/Winter 2023/24  
Course Outline

**CALENDAR/COURSE DESCRIPTION**

Thermal Systems Design covers the physics and design of energy conversion systems utilized in many engineering systems. The course presents the underlying physics, thermodynamics and energy transfer applied in energy systems design. The topics include:

- 1) Energy and Work
- 2) First Law of Thermodynamics and Applications
- 3) The Second Law of Thermodynamics
- 4) Entropy and Reversibility
- 5) Power Systems and Cycles
- 6) Design Considerations for Energy Systems
- 7) Energy systems and their environmental applications will be emphasized throughout the course

The emphasis of the lectures will be understanding the applied aspects of thermodynamics through case studies and examples. Attendance in the lectures and the tutorial is considered compulsory.

**PRE-REQUISITES AND ANTI-REQUISITES**

Prerequisite(s): None  
Antirequisite(s): ME 2W04

**INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION**

**Dr. Novog**  
  
NRB 119  
[novog@mcmaster.ca](mailto:novog@mcmaster.ca)

**Office Hours (please email to set up an online meeting):**  
Monday – 11-12 am  
Thursday – 1-2 pm  
Or anytime by appointment

**TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION**

<b>Catherine Boyetey</b>	<a href="mailto:boyeteyc@mcmaster.ca">boyeteyc@mcmaster.ca</a>
<b>Nathan Mcleod</b>	<a href="mailto:mcleon9@mcmaster.ca">mcleon9@mcmaster.ca</a>
<b>Razia Nushrat</b>	<a href="mailto:nushratr@mcmaster.ca">nushratr@mcmaster.ca</a>
<b>Emmanuel Osei Tutu</b>	<a href="mailto:oseitute@mcmaster.ca">oseitute@mcmaster.ca</a>

**Office Hours:**

**COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION**

<http://avenue.mcmaster.ca/>

Lectures will be given in person during the lecture periods and attendance at all lectures is required. Online synchronous lectures will only be available should COVID circumstances dictate.

In-person tutorials attendance is MANDATORY as quizzes, discussions and important aspects of the class will take place in the tutorial slot. In the event that COVID restrictions do not allow for in-person tutorials, tutorials will take place online during the designated timeslot and students must participate during the required time.

#### COURSE INTENDED LEARNING OUTCOMES

By the end of this course, students should be able to:

- Understand the important thermodynamic properties of pure substances and the definition of state variables to describe a thermodynamic system. Students should be able to demonstrate their understanding by using tables and software to identify thermodynamic properties.
- Understand a wide variety of ideal and non-ideal thermodynamic processes and how these mimic realistic processes in engineering systems. Students should be able to demonstrate their knowledge by performing calculation to model these processes and the associated change of state. Advanced knowledge would be to consider the important elements and constraints of these processes that limit the performance of engineering systems.
- Understand and apply the first and second laws of thermodynamics in terms of the engineering processes used in thermal energy systems. Including reversible and non-reversible processes.
- Understand the various processes and their linkages as applied to modelling thermodynamic cycles used in energy systems like power plants and transportation engines as well as refrigeration processes and apply this knowledge to estimate cycle efficiencies and energy flows.
- Be able to identify the sources of irreversibility in thermodynamic processes as well as the physical constraints involved in these processes.

#### MATERIALS AND FEES

##### Required Texts:

“Fundamentals of Thermal Fluid Sciences” by Cengel, Cimbala and Turner. The same book will be adopted in EP 3004 in Year 3. **Any version of the textbook is acceptable but it is the students responsibility to ensure any assigned questions from the 6<sup>th</sup> edition are used.**

##### Recommended Additional Texts:

None.

##### Calculator:

Only the McMaster Standard Calculator will be permitted in tests and examinations. This is available at the Campus Store.

#### COURSE FORMAT AND EXPECTATIONS

The course is organized as follows:

- 3 in-person lectures held each week during the lecture period.
- 1 tutorial per week during the tutorial slot. All quizzes will take place within the tutorial time slot so attendance is mandatory. Tutorials will be in person covid restrictions permitting.

### COURSE SCHEDULE

Date/Week	Topic	Readings/ Chapters
1	Intro – Properties, States, State Diagrams	2.all
2	Properties of Pure Substances and Mixtures	4.all
3-4	Energy, Heat, and Work	3.all
4-5	The 1st Law of Thermodynamics, conservation of mass, and applications	5.all, 6.all
6	The Second Law of Thermodynamics	7.all
6-7	Entropy, Reversibility and Irreversibility	8.1-8.11
8-10	Ideal and Non-Ideal Power Production Cycles (Rankine and Brayton Cycles, Otto and Diesel Cycles time permitting)	9.1-9.3, 9.7-9.13 (other sections of Chpt9 as time permits)
10	Sustainability Aspects in Power Production (time permitting)	In-class notes

### ASSESSMENT

Component	Due Date	Weight
Problem Based Component		20%
Quizzes		40%
Final Exam		40%
Total		100%

### 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
<b>Determine state changes during a thermodynamic process.</b>	1.2
<b>Apply the first and second law to determine the changes in state due to heat and work and determine cyclic efficiencies</b>	1.3
<b>Apply assumptions and simplifications to complex thermo processes</b>	3.2

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.

#### AUTHENTICITY / PLAGIARISM DETECTION

**Some courses may** use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to [www.mcmaster.ca/academicintegrity](http://www.mcmaster.ca/academicintegrity).

#### 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

1. An MSAF or approval of the Associates Dean’s Office is required for any missed work. Missed work without an accompanying MSAF will be assigned a zero.
2. For term work and quizzes missed marks will be prorated based on grades at the end of term only if an acceptable msaf has been issued.
3. All questions related to making, making schemes, and assigned marks should be provided by email to the course instructor within 2 weeks of receiving the grade. Included in the email should be an image of the work which was incorrectly marked, an image showing the correct solution, and a description of what the issue was in the marking. No grade change requests will be processed without this documentation.

#### 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.
  - 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 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.