# Course Syllabus

(NOTE: This is a preliminary draft of the course syllabus. The final version will be provided at the end of the first week of classes)

## 1. Course Information

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|---|---|---|
| ME 3322 | | Thermodynamics [We will have 2 classes (~4hrs total)/week] |
| **Mondays/Tuesdays** | **:** | **~1 hour 55 minutes** |
| **Wednesdays/Thursdays** | **:** | **~1 hour 55 minutes** |
| NOTE :Days and time table | : | will be confirmed soon |

## 2. Instructor & Grader Information

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|---|---|
| Instructor & Grader: | Dr. Louis SATYANARAYAN Ph.D. |
| Email : | Louis.Satyanarayan@georgiatech-metz.fr |
| Office Room Number: | 226 |
| Office Hours (by appointment): | Mondays/Wednesdays: 11:00AM – 12:30PM |
| | Tuesdays/Thursdays: 03:30 PM – 05:30 PM |

I am flexible for my students and always available for short questions or concerns just after class.

If required you may also send an email to make an appointment or come directly to my office in the slots given above.

**Some tips to do well in this course:**

- Be present in all classes
- Complete and submit all home-works in time
- Make sure you understand the concepts. If not, feel free to ask questions
- Take advantage of my availability outside of class hours
- Feel free to discuss if there is a problem in the subject, do not hesitate to talk to me;
- Important topics / concepts will be highlighted during the class relevant to the quizzes/exams. Pay attention and note down important points.

## 3. General Information

- *Course Outline: ME 3322 THERMODYNAMICS*
  Introduction to thermodynamics. Thermodynamic properties, energy and mass conservation, entropy and the second law, and second law analysis. Thermodynamic analysis of power, refrigeration, and heat pump systems; vapor cycles and gas cycles.
- BRING A CALCULATOR TO THE CLASS REGULARLY
- Classes will be a good mix of lectures, problem solving sessions, real-life examples and interesting discussions on the subject.

- The lectures will try to balance theoretical concepts and practical examples so that the students can appreciate both aspects.
- Many example problems will be presented during the lectures that show how to use effective problem-solving strategies in the analysis of fatigue
- Two case-studies will be included to help the students appreciate the problems faced by the industry and how a solution was arrived at.
- Repetition and practice are the best methods for developing the problem-solving skills that are a primary outcome of this course.

**4. Pre &/or CoRequisites**

Pre-requisites:

- PHYS 2211 Intro Physics I and
- MATH 2403 Differential Equations

**5. Textbook:**

Michael J. Moran, Howard N. Shapiro, Daisie D. Boettner, and Margaret B. Bailey, Fundamentals of Engineering Thermodynamics, 6 th/7th Edition, John Wiley & Sons, 2011.

**6. Syllabus/Topics covered**

| | |
|---|---|
| **Objective** | To teach the basic principles and provide a working knowledge thermodynamics and associated physical processes, with emphasis on practical applications. |

## Course Overview

| No. | Chapter Name | Description |
|---|---|---|
| 1 | Definitions | Property, state, closed and open systems, temperature, pressure, work interactions, and heat transfer. State postulate. |
| 2 | Forms of energy | Kinetic, potential, and internal. |
| 3 | Properties of pure substances | Equilibrium diagrams, and quality. Ideal gas and incompressible substances. |
| | **Quiz 1** | |
| 4 | Conservation of mass | Closed and open systems, and steady and transient processes. |
| 5 | Conservation of energy | Closed and open systems, and steady and transient processes. |
| 6 | Introduction to the second law | Entropy, Tds equations, irreversibility, and isentropic efficiency |
| | **Quiz 2** | |
| 7 | Second law analysis | Closed and open systems, and steady and transient processes. |

| | | |
|---|---|---|
| 8 | Power, refrigeration, and heat pump systems | Vapor cycles (e.g., ideal, Rankine, and vapor-compression); and air standard analysis of gas cycles (e.g., ideal, Brayton, Otto, and diesel). |
| 9 | Additional second law topics (with practical applications) | Kelvin-Planck and Clausius statements, the Clausius inequality, and exergy (availability) |
| | **Quiz 3** | |
| 10 | Optional topics (with practical applications) | Methods to improve cycle performance, including reheat, regeneration, and intercooling. |
| | **Final Exam** | |

**7. Course Outcomes:**

Outcome 1: To teach students the basic principles of classical thermodynamics.

1.1 Students will demonstrate an understanding of the concepts of conservation of mass, conservation of energy, and the second law of thermodynamics.

1.2 Students will demonstrate an understanding of the concepts of work interaction and heat transfer.

1.3 Students will demonstrate an understanding of methods for determining thermodynamic properties of simple compressible substances, incompressible substances, and ideal gases.

Outcome 2: To train students to identify, formulate, and solve engineering problems in classical thermodynamics involving closed and open systems for both steady state and transient processes.

2.1 Students will demonstrate the ability to identify closed and open systems.

2.2 Students will demonstrate the ability to identify work interactions and heat transfer.

2.3 Students will demonstrate the ability to determine accurately the thermodynamic properties of simple compressible substances, incompressible substances, and ideal gases.

2.4 Students will demonstrate that they can apply the principles of conservation of mass and energy to the solution of problems.

Outcome 3: To train students in the application of a second law analysis to a thermodynamic system.

3.1 Students will demonstrate an understanding of the concepts of the second law including entropy, irreversibility, and the isentropic efficiency.

3.2 Students will demonstrate that they can apply a second law analysis to the solution of problems involving closed and open systems for both steady and transient processes.

Outcome 4: To train students to analyze the performance of power, refrigeration, and heat pump cycles.

4.1 Students will demonstrate that they can apply the principles of conservation of mass, conservation of energy, and the second law of thermodynamics to thermodynamic cycles.

4.2 Students will demonstrate the ability to analyze the performance of vapor and gas power cycles.

4.3 Students will demonstrate the ability to analyze the performance of vapor and gas refrigeration and heat pump cycles

**8. Correlation between Course Outcomes and Student Outcomes:**

| **ME 3322 THERMODYNAMICS** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Mechanical Engineering Student Outcomes** | | | | | | | | | | |
| **Course Outcomes** | **a** | **b** | **c** | **d** | **e** | **f** | **g** | **h** | **i** | **j** | **k** |
| Outcome 1.1 | **x** | | | | **x** | | | | | | **x** |
| Outcome 1.2 | **x** | | | | **x** | | | | | | **x** |
| Outcome 1.3 | **x** | | | | **x** | | | | | | **x** |
| Outcome 2.1 | **x** | | | | **x** | | | | | | **x** |
| Outcome 2.2 | **x** | | | | **x** | | | | | | **x** |
| Outcome 2.3 | **x** | | | | **x** | | | | | | **x** |
| Outcome 2.4 | **x** | | | | **x** | | | | | | **x** |
| Outcome 3.1 | **x** | | | | **x** | | | | | | **x** |
| Outcome 3.2 | **x** | | | | **x** | | | | | | **x** |
| Outcome 4.1 | **x** | | | | **x** | | | | | | **x** |
| Outcome 4.2 | **x** | | | | **x** | | | | | | **x** |
| Outcome 4.3 | **x** | | | | **x** | | | | | | **x** |

**9. GWW School of Mechanical Engineering Student Outcomes:**

a. an ability to apply knowledge of mathematics, science and engineering
b. an ability to design and conduct experiments, as well as to analyze and interpret data
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. an ability to function on multidisciplinary teams
e. an ability to identify, formulate, and solve engineering problems
f. an understanding of professional and ethical responsibility
g. an ability to communicate effectively
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i. a recognition of the need for, and an ability to engage in life-long learning
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

**10. GT Academic Honor Code**

As usual the GT Academic Honor Code is followed for this class. Please check this link for clear information : http://www.honor.gatech.edu/plugins/content/index.php?id=9

**11. Canvas**

Your instructor uses CANVAS to send you messages and your results of homeworks and quizzes. You are supposed the check your ME7774 messages and announcements every day to make sure you don't miss anything. It is not guaranteed that the system will email you messages after being posted.

**12. GRADING**

**a. WEIGHT:**

- Quiz 1 : 20% (closed book, closed notes, will include Chapters 1-3, more info below)
- Quiz 2 : 20% (closed book, closed notes, will include Chapters 4-6, more info below)
- Quiz 3 : 20% (closed book, closed notes, will include Chapters 7-9, more info below)
- Final Exam: 25% (closed book, closed notes, All chapters from 1-11, more info below)
- Homework: 15% (each hw has the same weight, although some may take more time to solve than others)

You are however allowed to bring a calculator, a unit conversion sheet and also a cheat sheet maximum 2 sides of one A4-size sheet of paper, normal size letter type

**Note:** 1 cheat sheet can be made for each quiz and they can all be brought to the final exam (more precisely: 3 quizzes and one extra cheat sheet, i.e., 4 cheat sheets in total)

For each item or assignment, you will receive a numerical grade on canvas. These numbers must be interpreted as :

| | | |
|---|---|---|
| **90%-100%** | **:** | **A** |
| **80%-89.99%:** | | **B** |
| **70%-79.99%:** | | **C** |
| **60%-69.99%:** | | **D** |
| **below 60%** | **:** | **F** |

Should canvas make any calculation for you, ignore it, because it does not count the above-mentioned weights for each task.

**b. GRADING OF HOMEWORK:**

- Homework is graded as follows: For each homework problem, you receive full marks when

solved 100% correctly, 50% when solved incorrectly and 0% when not solved.

- They will all be graded on 100% and will therefore have an equal weight.
- You will receive 4 Homeworks (I will grade all the 4 HW but will take your 3 top performances)
- More precisely: Practically it means that I will ignore, for each student separately, his/her homework with the lowest marks.

**c. About Homeworks, Quizzes**

- All tasks will be submitted through CANVAS. The standard procedure is to upload pictures of your HW.
- A HW can be short or extensive, however each HW will have the same weight.
- A QUIZ will be turned in on paper when the exam is done.
- For homeworks you are allowed to work together and discuss with your colleagues, but you must turn in your own homework and not copy that of your colleagues or a solutions manual.

**d. Calendar (provisional dates given below– any changes will be posted on canvas as message to you)**

Quiz 1: June 3, 2024

Quiz 2: June 20, 2024

Quiz 3: July 3, 2024

Final exam: Date will be communicated later by GT Europe

**13. Course Expectations & Guidelines**

**a. BEHAVIOR IN CLASS :**

Class participation (being present, paying attention, asking questions if needed, ... ) is perfect. What is not OK is "noise". Noise means that you disturb your teacher and also your colleague students who equally paid their tuition fees and have the right to follow my class. For urgent matters, you are excused to leave class briefly and then to return (bathroom, water fountain, something urgent, ...) – do it quietly please.

**b. Academic Integrity**

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit

http://www.catalog.gatech.edu/policies/honor-code/ or

http://www.catalog.gatech.edu/rules/18/.

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

**c. Attendance and/or Participation**

Attendance and participation in class is required. If you miss class for any reason, it is your responsibility to obtain the notes for that day from a fellow student. This includes any announcements, concerns, helpful hints, etc. given by the instructor to the class.

**d. Collaboration & Group Work**

- Discussions between students on homework problems outside of class and during in-class problem solving sessions is encouraged.
- However, quizzes and exams must be written and submitted by each student independently.
- Copying and/or cutting and pasting someone else's work and submitting it as your own is not permitted.

**e. Extensions, Late Assignments, & Re-Scheduled/Missed Exams**

- No credit will be given for the late submission of any course work.
- It is your responsibility to ensure that your work is submitted to Canvas by the appropriate time.
- Any work missed because of Institute-approved activities (e.g., field trips and athletic events) can be made up.

**14. Acknowledgements (for making the core of this syllabus):**

This syllabus is based on the document provided by Prof. Nico F. Declercq with changes incorporated by Prof.Louis Satyanarayan