

# Fall 2024: ME 311 S001 Thermodynamics I



Department of Mechanical and Industrial Engineering  
New Jersey Institute of Technology (NJIT)  
Newark, NJ 07012, USA

**Instructor: Dr. Dibakar Datta**

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**Class:** Days/Times –Mondays/Wednesday (11:30 AM – 12:50 AM); Credits – 3.00

## ME 311 – THERMODYNAMICS I

| Section | CRN   | Days | Times               | Location | Status | Max | Now | Instructor   | Delivery Mode | Credits | Info  |
|---------|-------|------|---------------------|----------|--------|-----|-----|--|---------------|---------|---|
| 001     | 94327 | MW   | 11:30 AM – 12:50 PM | CULM 111 | Closed | 35  | 35  |  Datta, Dibakar | Face-to-Face  | 3       | <br>Book |

## TIMELINE: Lectures, Homework, Exam

| DATE              | LECTURE    | HOMEWORK  | EXAMINATION  |
|-------------------|------------|---|--|
| September 04      | Lecture 01 | <a href="#">Homework 01 given</a>   |  |
| September 09      | Lecture 02 |   |  |
| September 11      | Lecture 03 |   |  |
| September 16      | Lecture 04 |   |  |
| September 18      | Lecture 05 |   |  |
| September 23      | Lecture 06 | <a href="#">Homework 01 DUE</a><br><a href="#">Homework 01 solution given</a> |  |
| September 25      | Lecture 07 |   |  |
| September 30      | Lecture 08 | <a href="#">Homework 01 GRADE given</a>                                       |  |
| <b>October 02</b> |            |   | <b>Exam 01</b><br><a href="#">Exam 01 solution given</a> |
| October 07        | Lecture 09 | <a href="#">Homework 02 given</a>   |  |
| October 09        | Lecture 10 |   | <a href="#">Exam 01 GRADE given</a>                      |
| October 14        | Lecture 11 |   |  |
| October 16        | Lecture 12 |   |  |
| October 21        | Lecture 13 |   |  |

|  |            |  |  |
|--|------------|--|--|
| October 23   | Lecture 14 | <b>Homework 02 DUE</b><br>Homework 02 solution given |  |
| October 28   | Lecture 15 |  |  |
| October 30   | Lecture 16 | Homework 02 GRADE given                              |  |
| <b>November 04</b>                                     |            |  | <b>Exam 02</b><br>Exam 02 solution given |
| November 06  | Lecture 17 | Homework 03 given                                    |  |
| November 11  | Lecture 18 |  | Exam 02 GRADE given                      |
| November 13  | Lecture 19 |  |  |
| November 18  | Lecture 20 |  |  |
| November 20  | Lecture 21 |  |  |
| November 25  | Lecture 22 | <b>Homework 03 DUE</b><br>Homework 03 solution given |  |
| December 02  | Lecture 23 | Homework 03 GRADE given                              |  |
| <b>December 04</b>                                     |            |  | <b>Exam 03</b><br>Exam 03 solution given |
| December 09  | Lecture 24 |  |  |
| December 11  | Lecture 25 |  | Exam 03 GRADE given                      |
| <b>FINAL EXAM DATE AND TIME WILL BE ANNOUNCED SOON</b> |            |  |  |

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**Prerequisites:** Math 211- Calculus 111; Phys 111-Physics 1

**Book:** Yunus A. Cengel & Michael A. Boles; Thermodynamics - An Engineering Approach; 8<sup>th</sup> Edition; Published by McGraw-Hill Education

**Method of Lectures:** In-person.

**Office Hours:** There are no specific office hours. Please email me to schedule an appointment. We can meet in any day at our mutually convenient time.

**Lecture Notes and Study Materials:** We will NOT blindly follow this textbook. You will receive lecture notes/slides and additional study materials in every class. Moreover, you will be provided many videos for a clear understanding of the concept.

## Academic Integrity:

*“Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: <http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf>.*

## NJIT's Perspective on AI Usage in Teaching/Learning:

<https://www.njit.edu/emergingtech/njits-perspective-ai-usage-teachinglearning#tab-2>

## Course Description:

Thermodynamic fundamentals. Introduction to the basic concept of energy and the laws governing the transfer and transformation of energy. Thermodynamic properties and the application of the first and second laws of thermodynamics in the analysis of closed and open systems. Availability analysis is introduced. These concepts are then integrated into the analysis of simple cycles.

## Outcome of the course:

1. Identify the properties of real substances, such as water from tabular data, ideal gases from tabular data or equation of state and other real gases P,v,T, data through the use of the compressibility charts.
2. Analyze processes involving real substances and ideal gases as working fluid in both the open and closed systems, apply the first law, the conservation of mass to perform both mass and energy balances, sketch process diagrams, and to determine work and heat transfers.
3. Analyze open and closed systems through the application of the second law of thermodynamics as well as applying the energy concept.
4. Analyze some simple thermodynamic cycles.

## Grading Policy:

**There will be NO generosity in grading. Your final grading will be EXACTLY based on your performance in the exams.**

**The final grading will be based on three homework, three exams, one final exam.**

**(1) Three Homework (3 x 10 = 30%)**

(2) Three Mid-Term Exams (3 x 15 = 45%)

(3) Final Exam (25%)

### Final Grading

| Grades    | Significance           | Overall Score   |
|-----------|------------------------|-----------------|
| <b>A</b>  | <b>Superior</b>        | <b>90 - 100</b> |
| <b>B+</b> | <b>Excellent</b>       | <b>80 - 89</b>  |
| <b>B</b>  | <b>Very Good</b>       | <b>70 - 79</b>  |
| <b>C+</b> | <b>Good</b>            | <b>60 - 69</b>  |
| <b>C</b>  | <b>Acceptable</b>      | <b>50 - 59</b>  |
| <b>D</b>  | <b>Minimum</b>         | <b>40 - 49</b>  |
| <b>F</b>  | <b>Fail/Inadequate</b> | <b>&lt; 40</b>  |

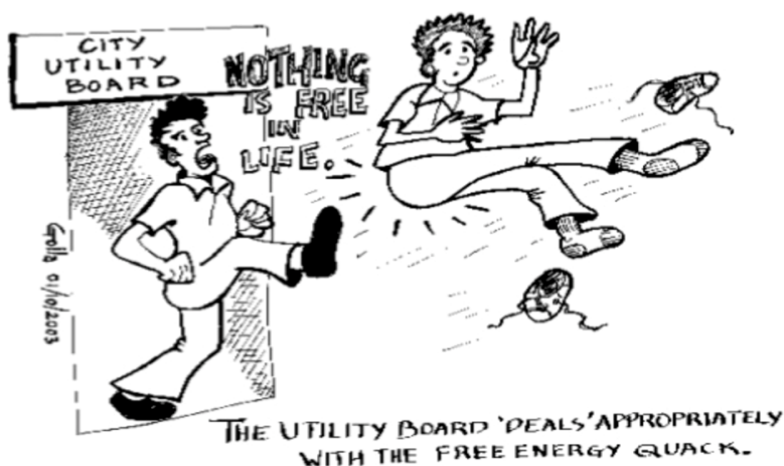
### Timeline and Syllabus

| Week             | Topic  |
|------------------|--|
| <b>1 &amp; 2</b> | <b>Introduction and Basic Concepts</b><br><br>Thermodynamics and Energy, Importance of Dimensions and Units, Systems and Control Volumes, Properties of a System, Density and Specific Gravity, State and Equilibrium, Processes and Cycles, Temperature and the Zeroth Law of Thermodynamics, Pressure, Pressure Measurement Devices, Problem-Solving Technique |
| <b>2 &amp; 3</b> | <b>Energy, Energy Transfer, and general Energy Analysis</b><br><br>Forms of Energy, Energy Transfer by Heat, Energy Transfer by Work, Mechanical Forms of Work, The First Law of Thermodynamics, Energy Conversion Efficiencies, Energy and Environment  |
| <b>4 &amp; 5</b> | <b>Properties of Pure Substances</b><br><br>Pure Substance, Phases of a Pure Substance, Phase-Change Processes of Pure Substances, Property Diagrams for Phase-Change Processes, Property Tables, The Ideal-Gas Equation of State, Compressibility Factor—A Measure of Deviation from Ideal-Gas Behavior, Other Equations of State                               |
| <b>6 &amp; 7</b> | <b>Energy Analysis and Closed Systems</b>  |

|                        |   |
|------------------------|---|
|                        | Moving Boundary Work, Energy Balance for Closed Systems, Specific Heats, Internal Energy, Enthalpy, and Specific Heats of Ideal Gases, Internal Energy, Enthalpy, and Specific Heats of Solids and Liquids  |
| <b>7 &amp; 8</b>       | <b>Mass and Energy Analysis of Control Volumes</b><br><br>Conservation of Mass, Flow Work and the Energy of a Flowing Fluid, Energy Analysis of Steady-Flow Systems, Some Steady-Flow Engineering Devices, Energy Analysis of Unsteady-Flow Processes   |
| <b>9, 10 &amp; 11</b>  | <b>The Second Law of Thermodynamics</b><br><br>Introduction to the Second Law, Thermal Energy Reservoirs, Heat Engines, Refrigerators and Heat Pumps, Perpetual-Motion Machines, Reversible and Irreversible Processes, The Carnot Cycle, The Carnot Principles, The Thermodynamic Temperature Scale, The Carnot Heat Engine, The Carnot Refrigerator and Heat Pump                                       |
| <b>12, 13 &amp; 14</b> | <b>Entropy</b><br><br>Entropy, The Increase of Entropy Principle, Entropy Change of Pure Substances, Isentropic Processes, Property Diagrams Involving Entropy, What Is Entropy? The Tds Relations, Entropy Change of Liquids and Solids, The Entropy Change of Ideal Gases, Reversible Steady-Flow Work, Minimizing the Compressor Work, Isentropic Efficiencies of Steady-Flow Devices, Entropy Balance |

**Nothing is free in life! You must work hard to shine in your life.**

**What is Free Energy?**



(Picture from Web)