Spring 2024

ME 311-002: ThermodynamicsI

Dibakar Datta

Spring 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 –Wednesday/Fridays (10:00 AM – 11:20 AM); Credits – 3.00

ME 311 - THERMODYNAMICS I

Section	CRN	Days	Times	Location	Status	Max	Now	Instructor	Delivery Mode	Credits	Info
002	14032	WF	10:00 AM - 11:20 AM	KUPF 204	Closed	35	35	Datta, Dibakar	Face-to-Face	3	Book

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

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

Method of Lectures: In-person.

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.

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.

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.

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 five exams.

(1) Four Mid-Term Examinations (4 x 18 = 72%)

(2) Final Exam (28%)

TENTATIVE EXAM DATES:

- **Mid-Term Exam 1 – Mid February**
- **Mid-Term Exam 2 – Mid March**
- **Mid-Term Exam 3 – Mid April**
- **Mid-Term Exam 4 – May First Week**
- **FINAL – To Be Announced**
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There will NOT be any homework for grading. However, you will get practice problem sets (not for grading). Those problem sets will be discussed in the class.

Final Grading

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

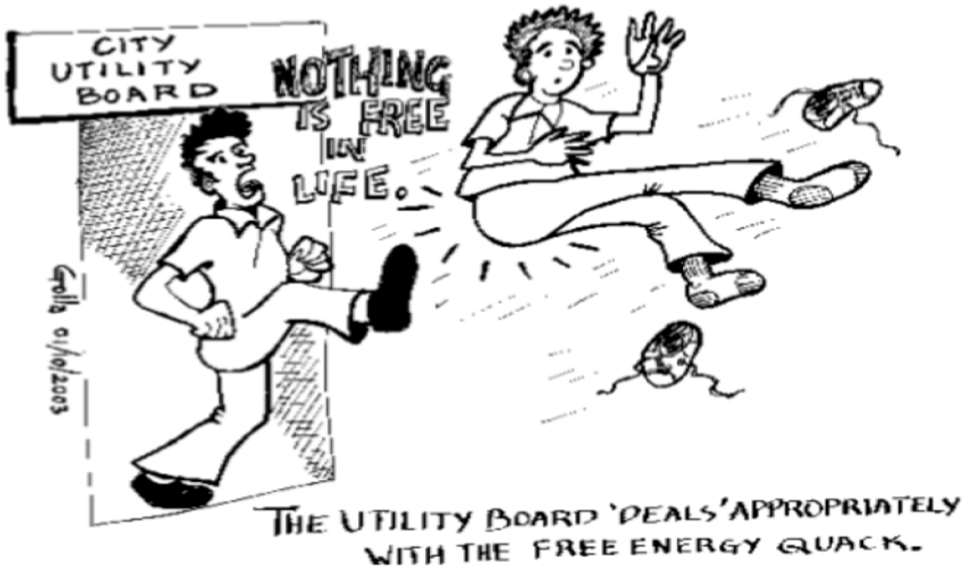
Timeline and Syllabus

Week	Topic
1 & 2	**Introduction and Basic Concepts** 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
2 & 3	**Energy, Energy Transfer, and general Energy Analysis** 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
4 & 5	**Properties of Pure Substances** 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
6 & 7	**Energy Analysis and Closed Systems** 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
7 & 8	**Mass and Energy Analysis of Control Volumes** 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
9, 10 & 11	**The Second Law of Thermodynamics** 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
12, 13 & 14	**Entropy** Entropy, The Increase of Entropy Principle, Entropy Change of Pure Substances, Isentropic Processes, Property Diagrams Involving Entropy, What Is Entropy? The T ds 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)