

ChE221A: Chemical Engineering Thermodynamics (3-0-0-9)

Lecturer: Professor Vishal Agarwal
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Lectures: _____
Office Hours: _____ or by appointment

Assessment: 10% for attendance (95% attendance is compulsory) and effort (class participation, questions regarding HW during office hours etc.), 30% for assignments (and quizzes), 30% for mid-sem, 30% for end-sem. **Zero-tolerance policy on academic dishonesty.**
 If attendance criteria is not met you will be de-registered.

Assignments: Practice problems, Reading assignments, and Home assignments (every week).
 On due date you will be given half-hour to solve one problem picked by me from the assignments (open notes) or you will have a quiz on fundamentals taught in the class (closed notes).

Examination: 3hrs. One make-up exam at the end of the semester for those who missed the end/mid-sem with a valid reason verified by DOAA office.

Course Contents. Approximate number of lectures for each topic are given below. I might make slight modifications as the course progresses.

Topic	Lectures
Laws of Thermodynamics: Introduction, Work, Heat, Energy, Review of First Law for closed and open systems, properties of ideal gas and real fluids	1
Reversibility and Entropy: Reversibility, the second law of thermodynamics, Carnot engine, entropy change for closed and open system	1
Fundamental Equations: Thermodynamic calculus, thermodynamic derivatives, Euler's theorem for homogeneous functions, Legendre's transformations, Derivative in terms of measurable properties.	3
Equilibria and stability: Equilibrium criteria, stability criteria, Maxwell construction, binodals, spinodals, Gibbs phase rule, Clapeyron equation and vapor pressure correlations	4
Pure component properties: Equation of state, ideal gas heat capacities, fundamental equations from experimental data, fugacity and corresponding states	5
Mixture properties: Mixing function, partial molar quantities, Gibbs-Duhem relation for mixtures, partial Molar quantities from experimental data, Ideal gas mixtures and fugacities, Ideal mixtures and activities, excess functions, excess Gibbs free energy models, infinite dilution properties and Henry's law	9
Chemical reaction equilibria: Reaction extent and independent reactions, equilibria criteria and equilibrium constant, reaction standard enthalpies and Gibbs free energy, temperature and pressure effects on reaction, heterogeneous reaction, multiple chemical reactions	6
Phase equilibria of mixtures: VLE, LLE, VLLE, Phase equilibria equation of state, Osmotic pressure and Osmotic coefficients, Boiling point elevation and freezing point depression	8
Microscopic origin of entropy and elementary statistical mechanics	3
Total	40

Teaching Assistants: Abir Lal Bose abirlal@iitk.ac.in
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Textbook

1. Callen, H. B. (1998). Thermodynamics and an Introduction to Thermostatistics.
2. Smith, J. M., Van Ness, H. C., & Abbott, M. M. (2005). Introduction to Chemical Engineering Thermodynamics, 7th ed.

Other Suggested References

1. Elliott, J. R., & Lira, C. T. (2012). Introductory chemical engineering thermodynamics, 2nd ed. Upper Saddle River, NJ: Prentice Hall PTR.
2. Rao, Y. V. C. (1997). Chemical engineering thermodynamics. Universities Press.
3. Metiu, H. (2006). Physical chemistry: thermodynamics. Garland Science.

Some Points to Keep in Mind.

1. **Learning is your responsibility.** It is my responsibility to teach but it your responsibility to learn. Pay utmost attention during lectures, and keep up with the reading materials. Don't be shy, ask questions during lectures or after lectures. Please remember engaging is the best way to learn.
2. **Homework Problems.** First try working the homework problems independently. If you have difficulty moving forward even after several tries, please ask for help either from me during office hours or from TA's or from your peers. I encourage you to discuss homework problems in groups but when you sit down to finally write your homework, it should be done independently; and it should reflect your understanding of the problem.
3. **Grade is Just a Number.** Don't get into the race of just getting grades. Your aim should be to learn, understand, and master the subject. This requires a painful struggle through lectures, texts, and homeworks. Everyone has different backgrounds and has different speeds of learning; so invest the required time. Remember that: "Rome was not built in a day".
4. **Think Critically and Challenge Yourself.** Critical thinking is possibly one of the most important skill that will help you in whatever you do in life. This course is an opportunity to develop that habit. Think critically about what you read and about homework problems. Don't be satisfied by just solving problems or understanding course contents. Challenge yourself to go beyond the class lectures and homework problems.

Academic Dishonesty.

Please read the following carefully (taken from <https://www.winona.edu/business/96.asp>):

1. **Cheating:** Using or attempting to use unauthorized materials in any academic exercise or having someone else do work for you. Examples of cheating include looking at another student's paper during a test, bringing a crib sheet to a test, obtaining a copy of a test prior to the test date or submitting homework borrowed from another student.
2. **Deception and Misrepresentation:** Lying about or misrepresenting your work, academic records, or credentials. Examples of deception and misrepresentation include forging signatures, falsifying application credentials and misrepresenting group participation.
3. **Enabling Academic Dishonesty:** Helping someone else to commit an act of academic dishonesty. This would include giving someone else an academic assignment with the intent of allowing that person to copy it or allowing someone else to cheat from your test paper.
4. **Fabrication:** Refers to inventing or falsifying information. Examples of fabrication include drylabbing (inventing data) or making references to sources you did not use in academic assignments.
5. **Plagiarism:** Using the words or ideas of another writer without proper acknowledgement, so that they seem as if they are your own. Plagiarism includes behaviour such as copying someone else's work word for word, rewriting someone else's work with only minor word changes and/or summarizing someone else's work without acknowledging the source.

Pledge

I, do solemnly promise that

1. I will maintain the highest standards of academic honesty during this course.
2. I have carefully read above forms of academic dishonesty and I will not indulge in any of them. If I am caught indulging in any one of them, I deserve one and only one grade, i.e., F.
3. I will maintain at least 95% of attendance in this course.
4. I will not be late for this class.

"Try not be a man of SUCCESS but rather try to become a man of VALUE" — Albert Einstein