

# Applied Chemical Thermodynamics – Fall 2022

MME 3308 – CRN: 18784

**Professor: Darren M. Cone**

[dmcone@utep.edu](mailto:dmcone@utep.edu)

(915) 747-5785

Office Hours: M-W 10:30am – 12:00pm (or by appointment)

Office: M201B

## COURSE DESCRIPTION

First, second and third law of thermodynamics applied to material systems. Fundamental topics include thermochemistry, chemical equilibria, phased equilibria, solutions, activity, and electrochemical potentials.

Prerequisites: MME 2305 with a grade of “C” or better.

## TOPICS TO BE COVERED

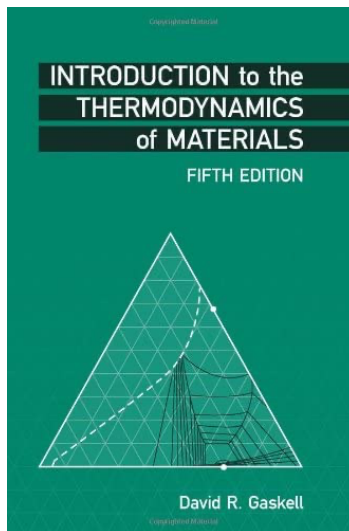
- First Law of Thermodynamics
- Forms of Energy, Heat and Work, Joules Experiments, Conservation of Energy, Concept of Maximum Work, Isothermal Expansion, Reversible, Adiabatic Expansion, Constant Pressure Processes, Constant Volume Processes, Enthalpy
- Second Law of Thermodynamics
- 2nd Law Statement, Carnot Cycle
- Statistical Entropy
- Physical Meaning of Entropy, Boltzman Equation, Mixing Entropy, Stirling's Approximation, Auxiliary Functions
- Fundamental Equations of State, Maxwell Relationships, Other Thermodynamic Relations, Chemical Potential, Gibbs-Helmholtz Equation, Criteria of Equilibria
- Heat Capacity and Entropy Changes
- Phase Equilibria in One Component Systems
- Clausius-Claperyon Equation, Heats of Vaporization From Vapor Pressure Data, Shift in Transformation Temperature with Pressure
- The Behavior of Gases
- Compressibility Factor, Law of Corresponding States, Equations of State, Fugacity Reactions Equilibria
- Equilibria in Gaseous Systems, The Equilibrium Constant and  $DG^\circ$ , Reaction Extent
- Problems, Equilibria in Systems Containing Condensed Phases, Ellingham Diagram, Activities
- Solution Thermodynamics
- Phase Equilibria and Electrochemistry

## EXPECTED LEARNING OUTCOMES

- Apply the concepts of energy, Isothermal expansion, reversible, adiabatic expansion, constant pressure processes & volume processes,  $\Delta U$ ,  $\Delta H$ ,  $q$ , and  $w$ , to determine the maximum work and heat added to or removed from the system.
- Describe the 1<sup>st</sup> and 2<sup>nd</sup> Law statement, Carnot Cycle, the statistical Entropy and calculate  $\Delta S^{\text{Mixing}}$  Stirling's Approximation, the Maxwell Relations, the criterion of equilibrium for systems at constant T and P
- Apply the Clausius and the Clausius-Claperyon equations to calculate the T and determine the  $K_{eq}$  for a reaction from  $\Delta G^\circ$  and analyze the equilibrium state (partial pressures, moles) for a reaction
- Apply the absolute relative and partial Integral molar quantities, ideal solutions, excess Quantities, Gibb's Duhem Equation, Tangent Intercept Method to analyze the materials and energy balance
- Analyze the activities and activity coefficients and calculate the cell potential for electrolytic cells involving dissolved components using Eh-pH Diagram or the Ellingham Diagram

## REQUIRED MATERIALS

Gaskell, *“Introduction to the Thermodynamics of Materials”*, 5<sup>th</sup> edition, Taylor and Francis.  
ISBN: 978-1439851500



Resources available via the UTEP library and the internet may also be necessary to complete some assignments, and additional literature material will occasionally be provided via Blackboard, as needed.

## **COURSE ASSIGNMENTS AND GRADING**

Assignments for this course are assessed according to rubrics. You can find these rubrics by clicking on the appropriate assignment link in Blackboard and choosing to “View Rubric” from the button beneath the Points Possible for the assignment.

### **Grade Distribution:**

100-90 = A    89-80 = B    79-70 = C    69-60 = D    59 and Below = F

60%    Exams (x3) (20% each)

20%    Homework Assignments

20%    Final Exam - Comprehensive

## **DEADLINES FOR HOMEWORK**

All homework assignments must be uploaded to Blackboard by 11:59 PM (mountain) on the due date listed. Late submissions will not be accepted and will be given a grade of zero.

## **TECHNOLOGY REQUIREMENTS**

This course will be taught in an **in-person format** but will maintain course content online to accommodate those students who may be required to remain off campus for health reasons. All online content will be distributed through the Blackboard learning management system. Students should ensure their UTEP e-mail account is working and that you have access to the internet with a stable web browser.

For MS Teams used for office hours as required, you need to have access to a computer/laptop with a webcam and a microphone. You will need to download and/or update the following software: Microsoft Office 365, available free to registered UTEP students. Check that your computer hardware and software are up-to-date and able to access all parts of the course. Click the following link for more information about [Microsoft Office 365](#).

**Important:** If you encounter technical difficulties beyond your scope of troubleshooting, please contact the UTEP [Help Desk](#) as they are trained specifically in assisting with technological needs of students. Please do not contact me for this type of technical assistance.

## **COURSE DROP POLICY**

According to UTEP Curriculum and Classroom Policies, “When, in the judgment of the instructor, a student has been absent to such a degree as to impair his or her status relative to

credit for the course, the instructor may drop the student from the class with a grade of “W” before the course drop deadline and with a grade of “F” after the course drop deadline.” See academic regulations in the UTEP Undergraduate Catalog for a list of excused absences. Therefore, if I find that, due to non-performance in the course, you are at risk of failing, I will drop you from the course. I will provide 24 hours advance notice via email.

Alternatively, if you feel that you are unable to complete the course successfully, please let me know and then contact the [Registrar’s Office](#) to initiate the drop process. If you do not, you are at risk of receiving an “F” for the course.

## **ACCOMMODATIONS POLICY**

The University is committed to providing reasonable accommodations and auxiliary services to students, staff, faculty, job applicants, applicants for admissions, and other beneficiaries of University programs, services and activities with documented disabilities in order to provide them with equal opportunities to participate in programs, services, and activities in compliance with sections 503 and 504 of the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act (ADA) of 1990 and the Americans with Disabilities Act Amendments Act (ADAAA) of 2008. Reasonable accommodations will be made unless it is determined that doing so would cause undue hardship on the University. Students requesting an accommodation based on a disability must register with the [UTEP Center for Accommodations and Support Services](#) (CASS). Contact the Center for Accommodations and Support Services at 915-747-5148, or email them at [cass@utep.edu](mailto:cass@utep.edu), or apply for accommodations online via the [CASS portal](#).

## **SCHOLASTIC INTEGRITY**

Academic dishonesty is prohibited and is considered a violation of the UTEP Handbook of Operating Procedures. It includes, but is not limited to, cheating, plagiarism, and collusion. Cheating may involve copying from or providing information to another student, possessing unauthorized materials during a test, or falsifying research data on laboratory reports. Plagiarism occurs when someone intentionally or knowingly represents the words or ideas of another as ones' own. Collusion involves collaborating with another person to commit any academically dishonest act. Any act of academic dishonesty attempted by a UTEP student is unacceptable and will not be tolerated. All suspected violations of academic integrity at The University of Texas at El Paso must be reported to the [Office of Student Conduct and Conflict Resolution \(OSCCR\)](#) for possible disciplinary action. To learn more, please visit [HOOP: Student Conduct and Discipline](#).

## **PLAGIARISM DETECTING SOFTWARE**

Some of your course work and assessments may be submitted to SafeAssign, a plagiarism detecting software. SafeAssign is used to review assignment submissions for originality and will help you learn how to properly attribute sources rather than paraphrase.

## **COPYRIGHT STATEMENT FOR COURSE MATERIALS**

All materials used in this course are protected by copyright law. The course materials are only for the use of students currently enrolled in this course and only for the purpose of this course. They may not be further disseminated.

## **STUDENT RESOURCES**

### **Technology Resources:**

[Help Desk](#): Students experiencing technological challenges (email, Blackboard, software, etc.) can submit a ticket to the UTEP Helpdesk for assistance. Contact the Helpdesk via phone, email, chat, website, or in person if on campus.

### **Academic Resources:**

[UTEP Library](#): Access a wide range of resources including online, full-text access to thousands of journals and eBooks plus reference service and librarian assistance for enrolled students.

[University Writing Center \(UWC\)](#): Submit papers here for assistance with writing style and formatting, ask a tutor for help and explore other writing resources.

[Math Tutoring Center \(MaRCS\)](#): Ask a tutor for help and explore other available math resources.

[History Tutoring Center \(HTC\)](#): Receive assistance with writing history papers, get help from a tutor and explore other history resources.

[RefWorks](#): A bibliographic citation tool; check out the RefWorks tutorial and Fact Sheet and Quick-Start Guide.

### **Individual Resources:**

[Military Student Success Center](#): Assists personnel in any branch of service to reach their educational goals.

[Center for Accommodations and Support Services](#): Assists students with ADA-related accommodations for coursework, housing, and internships.

[Counseling and Psychological Services](#): Provides a variety of counseling services including individual, couples, and group sessions as well as career and disability assessments.