CHE526: PINCH TECHNOLOGY

Department of Chemical Engineering

Landmark University,

Omu-Aran.


WELCOME

Lecturer Data

- Dr. M.S. Olakunle

  B.Sc(Hons), PGD(Chem. Eng), M.Eng, CASAP, PhD

- Department of Chemical Engineering,
  College of Science and Engineering
- **E-mail**: olakunle.michael@lmu.edu.ng
- **Office Location**: Room A005 FCB.

- **Consultation Hours**: **Monday –Thursday, 10:00 – 12:00p.m.**
- What else do you want to know about me?
- Let me also know you.

Recommended Textbooks

- Pinch Analysis and Process Integration: A user guide on Process Integration for the Efficient Use of Energy, 2nd Edition by Ian C. Kemp
- Energy Efficiency for Engineers and Technicians, 1st Edition by T.D. Eastop and D.R. Croft, Longman UK, 1990.

Course content

- Introduction to Thermodynamic Analysis
- Pinch Technology and Energy Savings
- Heat Exchanger Network (HEN) Representation
- Location of Pinch and Significance of Pinch
- Design for Maximum Energy Recovery
- Minimum Number of Heat Exchanger Units
- Splitting of Streams
- Matching of Units.

GROUND RULES!!!

- These are rules that will guide our operations in this course.
- It shall be binding on all.
- If flouted or disobeyed, there shall be consequences/penalties.
- What should they be? Let's set them together.

Additional Ground Rules for this course

- No late-coming (only 5 minutes of grace for a 1-hour and 10 minutes of grace for a 2-hour lectures) shall be condoned.
- Attendance is very compulsory and no writing of name(s) for your friend(s), i.e no attendance by proxy.
- No absenteeism without prior permission and genuine excuse
- 75% attendance university policy shall be strictly adhere to.
- No noise-making while lecture is going on
- No phone-making in class
- Assignment should be submitted on/before the scheduled date
- Continuous assessment shall constitute the following: attendance, SNQ, assignments, group project, mid-semester test etc. and all shall sum up to 30%, while examination shall be 70%. Make-up test shall not be given, except for genuine reason(s) authenticated by the appropriate organ of the university.

Learning Outcomes

- At the end of this course, students should be able to:
- Understand and explain the concept of pinch technology and energy savings
- Illustrate and evaluate heat exchanger network representations
- Apply the concepts to carry out pinch analysis, identify pinch point(s) and interprete their significances
- Design and evaluate maximum energy recovery for existing thermal system.
- Define targets for energy recovery, estimate minimum number of heat exchange units.

"The first step to knowledge is to know that we are ignorant".

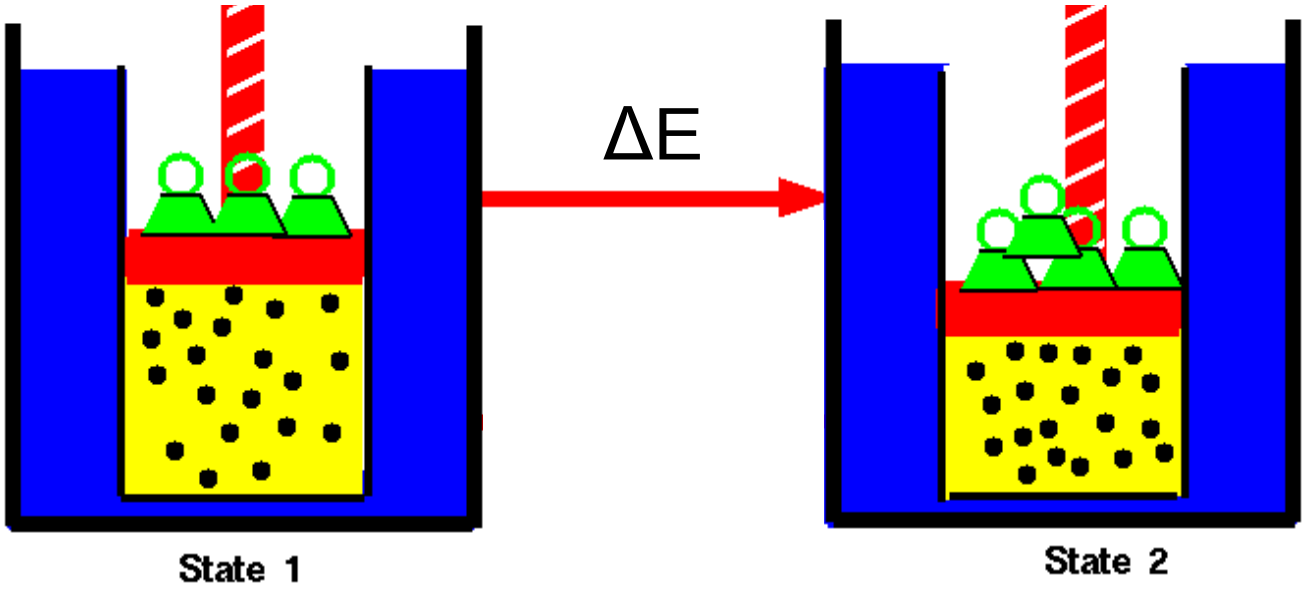
Socrates (470-399 B.C.)

Learning Objectives for today's lecture

- At the end of this lecture, students should be able to:
- Explain what thermodynamic process and cycle are, and give examples
- Illustrate why thermodynamic analyses are performed
- Recall the 1st and 2nd laws of thermodynamics and state their implications vis-à-vis analysis of processes
- Explain, define and illustrate what pinch technology entails
- State and explain the importance of process energy management
- Contextualize modern process integration in the light of its objectives and methods.

Introduction to Thermodynamic Analysis of Processes

What is a thermodynamic process?



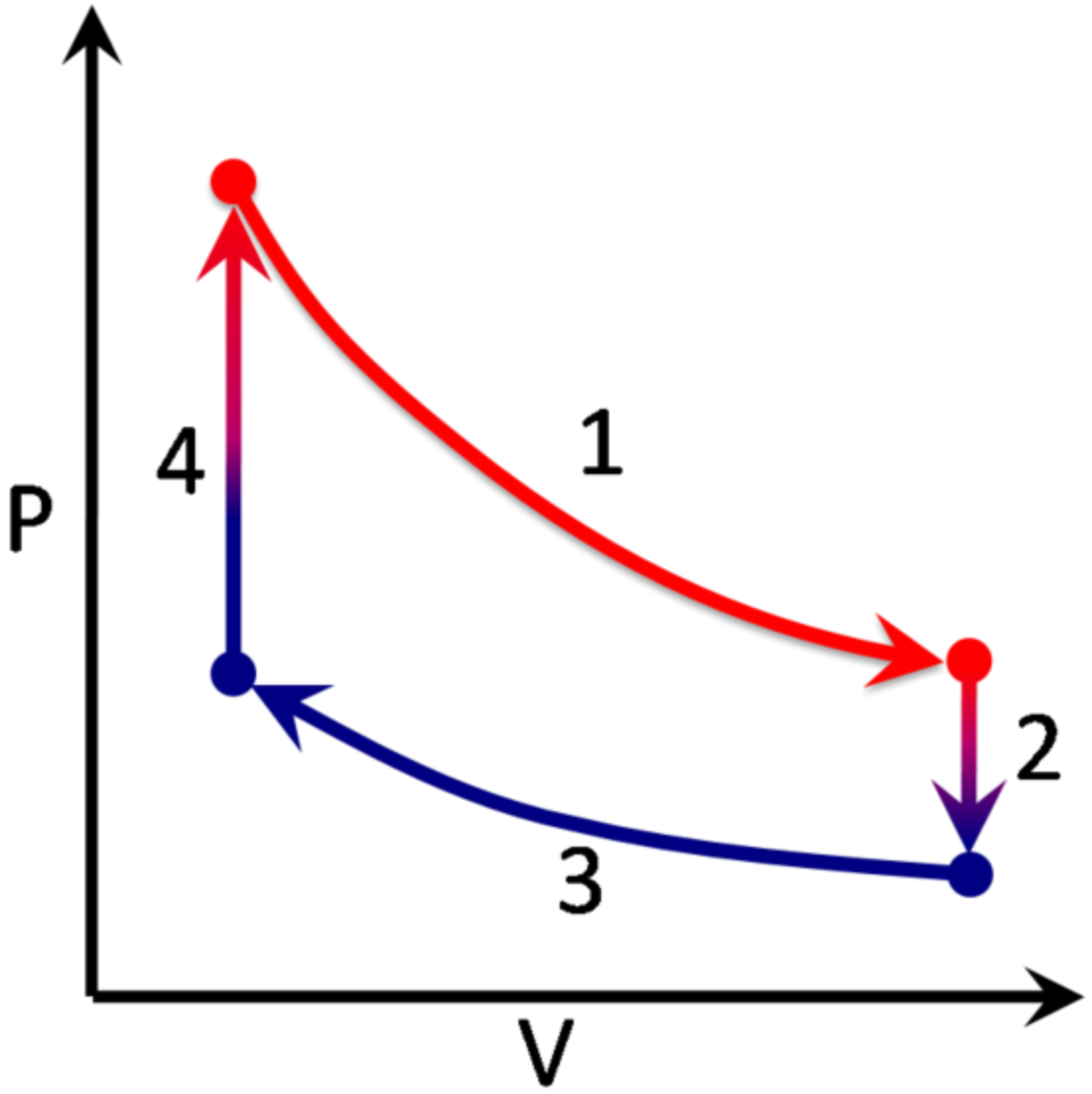
$$\Delta E = f(P_1, T_1, V_1, \ldots P_2, T_2, V_2)$$

- Thermodynamics is the science that deals with the relation between the properties of a system and the quantity of energy of all kinds that are transformed one to another which causes a change of state of matter in a system.

Analysis of Thermodynamic Processes.

- A **thermodynamic process** is the energetic development of a thermodynamic system proceeding from an initial state to a final state.
- Paths through the space of thermodynamic variables are often specified by holding certain thermodynamic variables constant.
  - A state function is a thermodynamic variable which depends only on the current state of the system, not the path taken to reach that state.
  - Conversely a process or path function does depend on the path.
- Let's mention examples:
- A process can be visualized by graphically plotting the changes to the system's state variables.

Example of stirling cycle



What is a thermodynamic cycle?

- A **thermodynamic cycle** consists of a collection of thermodynamic processes transferring heat and work, while varying pressure, temperature, and other state variables, eventually returning a system to its initial state.
- In the process of going through this cycle, the system may perform work on its surroundings, therefore acting as a heat engine.
- **Why do we have to carry out thermodynamic analysis?**
  - Efficiency concern
  - Optimization concern
  - Better understanding of "black-boxes" energy interconversion.

Recalling from the past……

- First law of thermodynamics: the law of conservation of energy.
  - What is the implication of the first law vis-à-vis analysis of processes?
- Second law of thermodynamics: the concept of entropy, and quality of energy.
  - What is the implication of the second law vis-à-vis analysis of thermodynamic processes.

THANK YOU FOR YOUR ATTENTION!

ANY QUESTIONS?