0905322- Chemical Engineering Thermodynamics I
Lecture 1: Introduction

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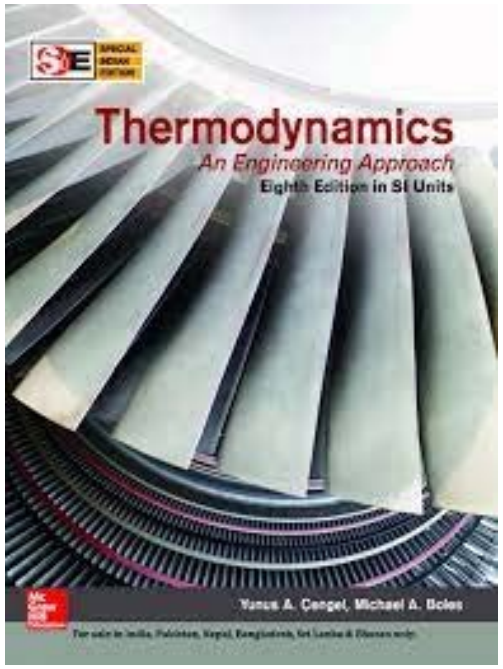
Outline

- What is Thermodynamics?
- Thermodynamic Postulates: Energy Transformation
- Thermodynamic Postulates: Property Relationships
- Macroscopic Versus Microscopic Approaches
- Road Map to Thermodynamics
- Road Map to Concepts
- Applications of Thermodynamics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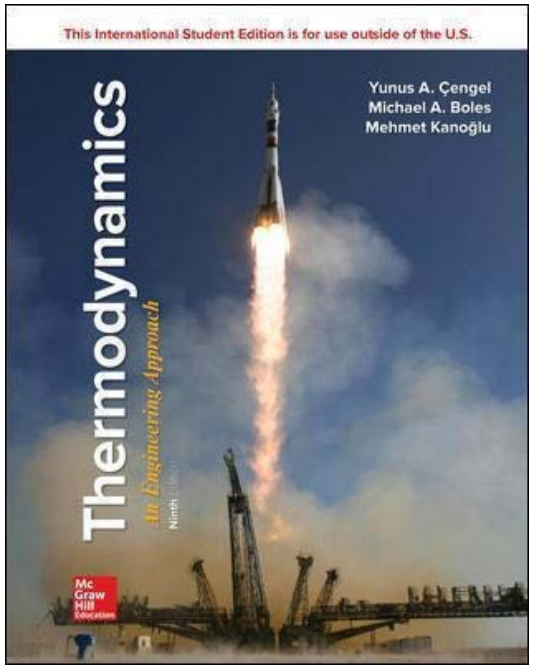
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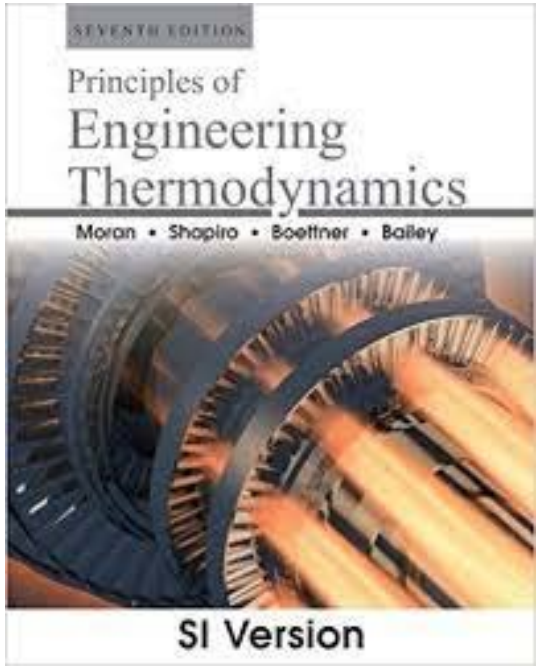
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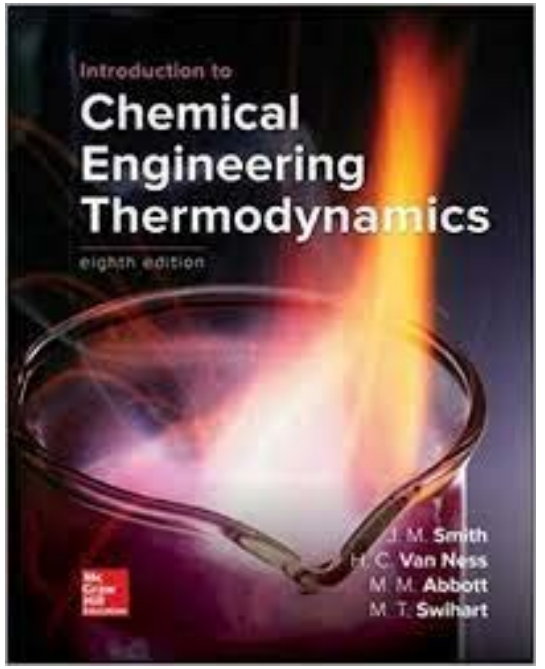
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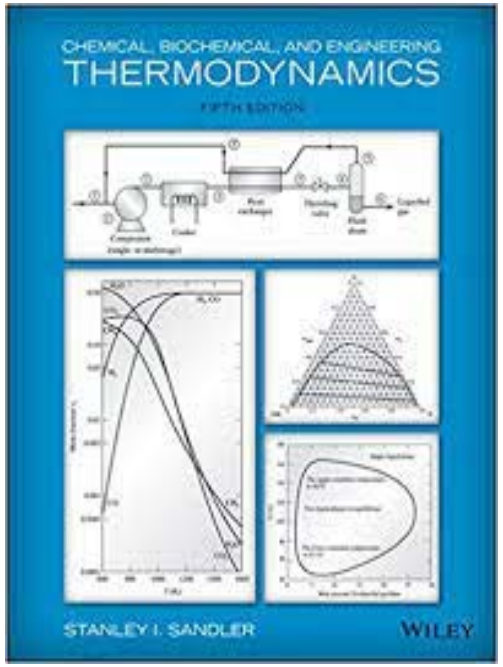
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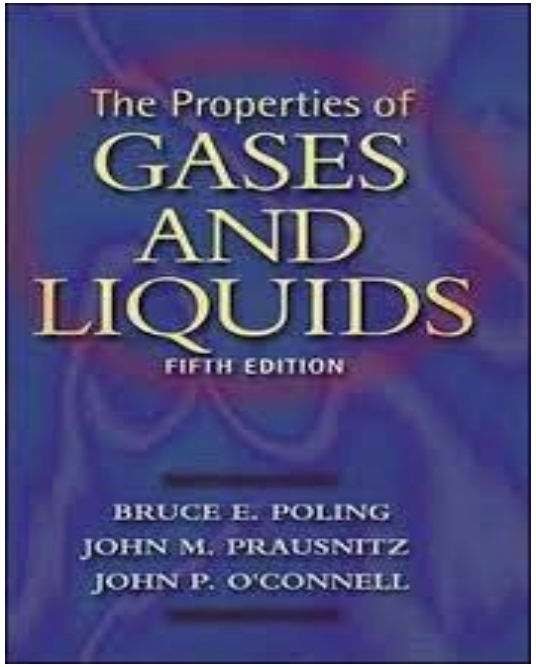
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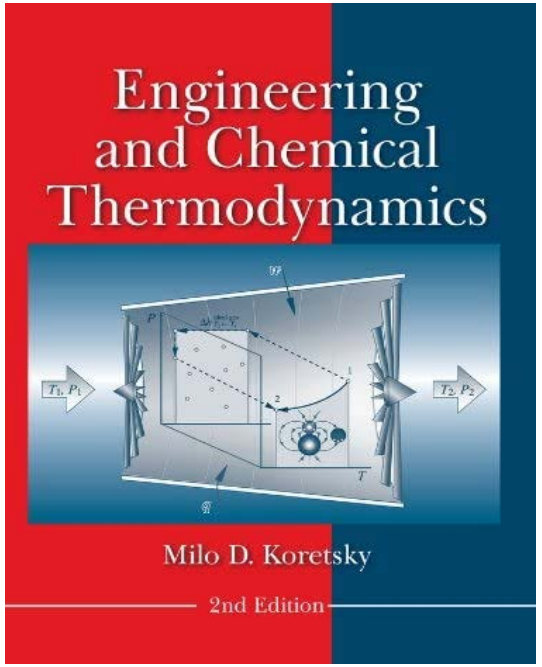
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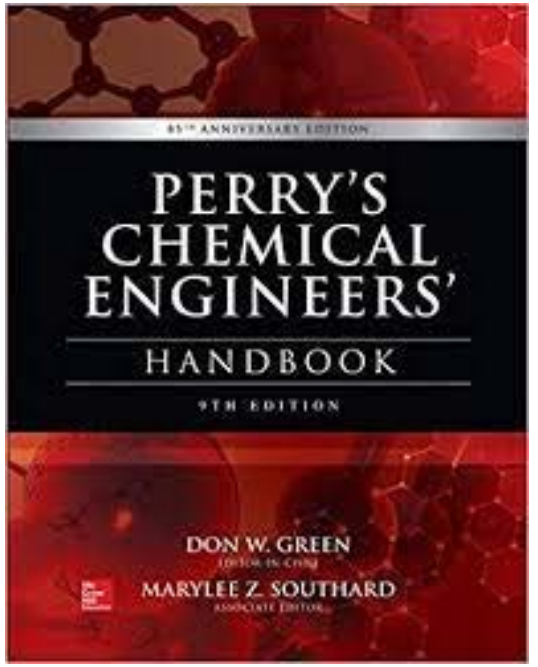
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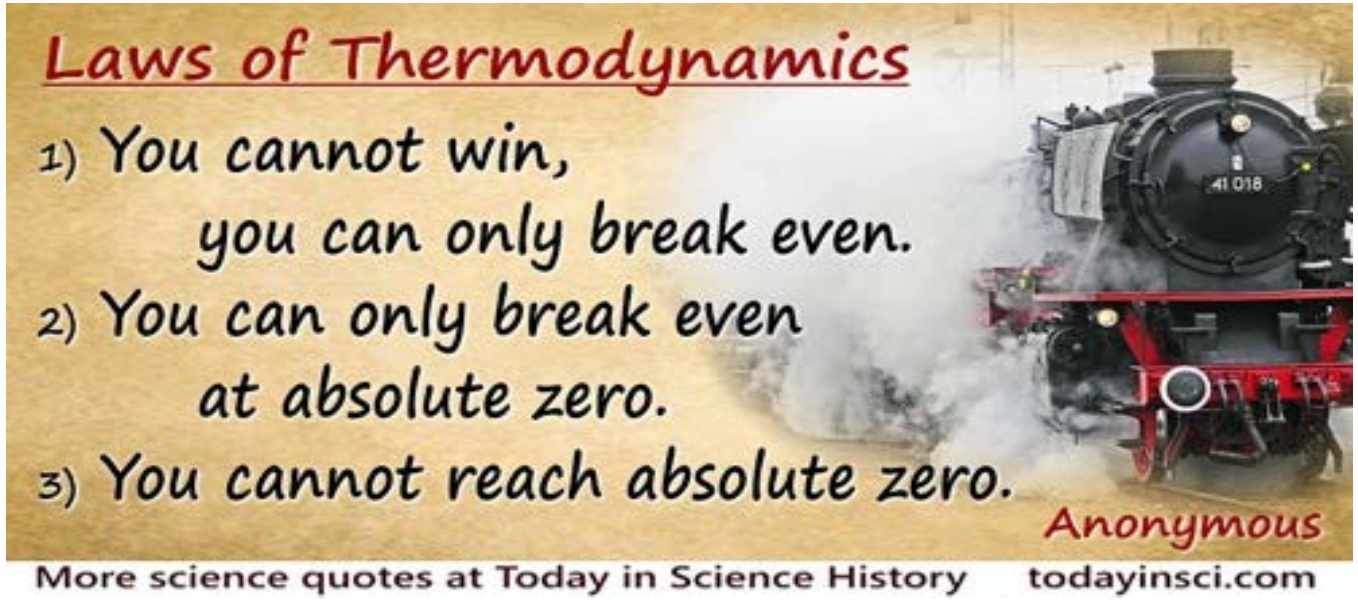
What is Thermodynamics?

- Thermodynamics is the study of the changes in the state or condition of a system when changes in its temperature, state of aggregation, or its internal energy are important.
- Thermodynamics is based upon experimental observation.
- Five postulates (laws) of thermodynamics.
  - Two postulates deal with **energy transformation**.
  - The other three deal with **properties**.

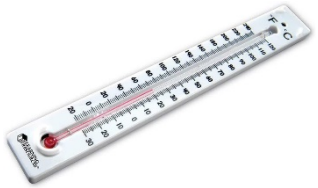
Thermodynamic Postulates: Energy Transformation

- **First law of thermodynamics**
  - Conservation of energy – you can't get more than what you invest.
- **Second law of thermodynamics**
  - It is not possible to convert all the energy of a system into useful work – you can eat as much as you want, eventually, something has to come out.

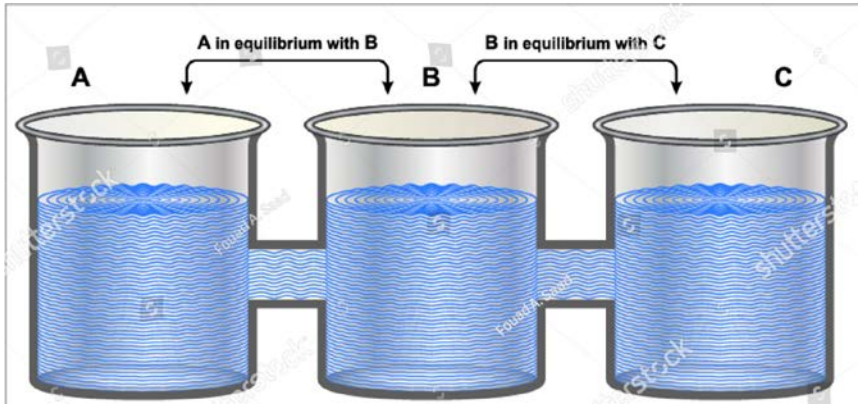


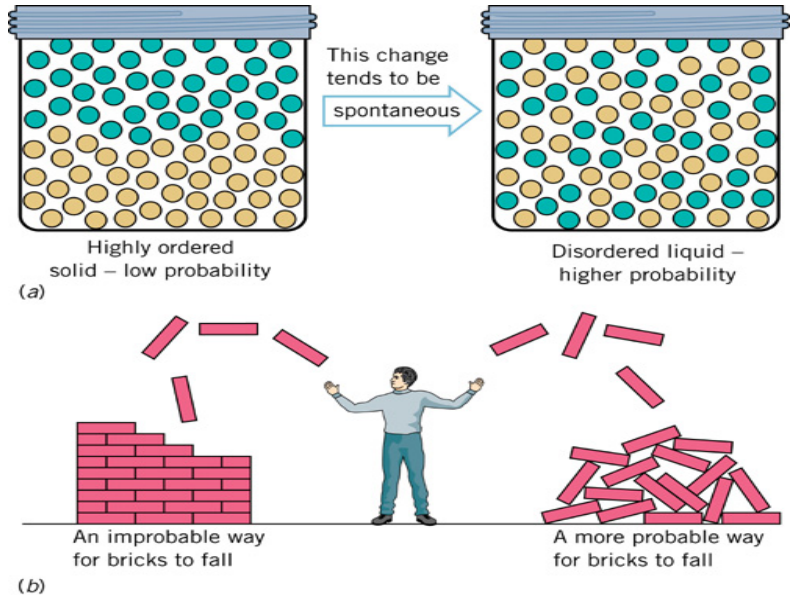
Thermodynamic Postulates: Property Relationships

- **Zeroth law of thermodynamics**
  - When each of two systems is in thermal equilibrium with a third system, they are also in thermal equilibrium with each other.



- **Third Law of Thermodynamics**
  - The entropy of a perfect crystal is zero at absolute zero temperature.
- **State Postulate**
  - The state of a simple, single phase thermodynamic system is completely specified by two independently variable, intensive properties.





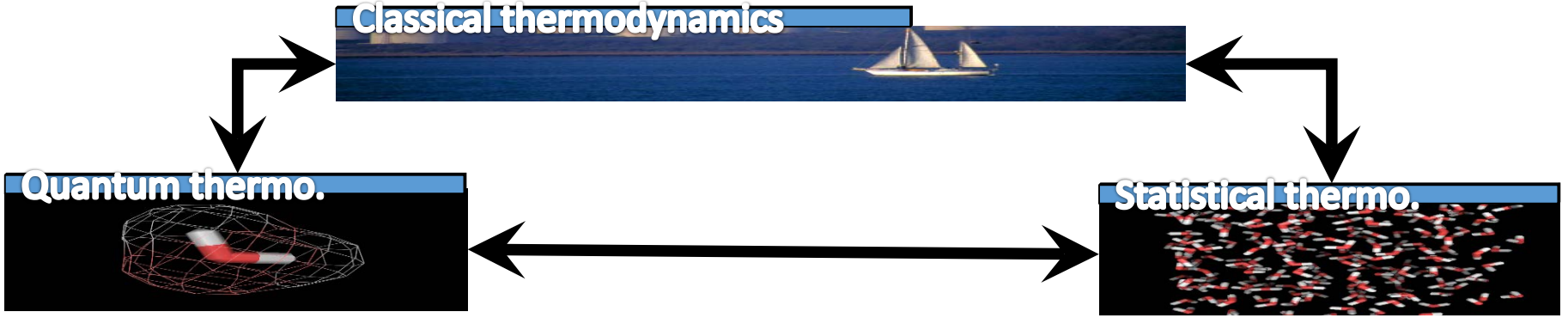
Macroscopic Versus Microscopic Approaches

Macroscopic

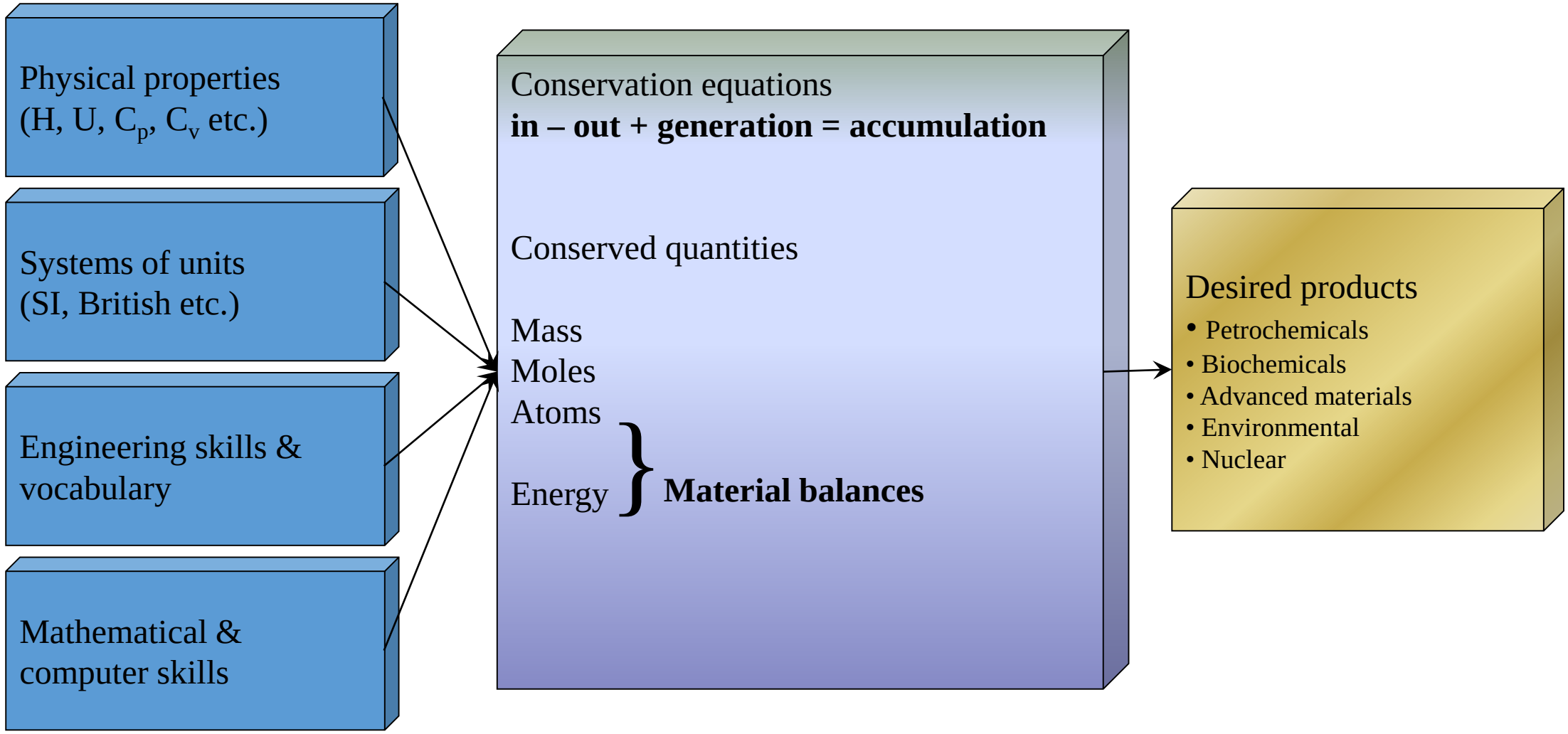
- system is considered as a **continuum**.
- The system is described by few variables e.g. P, T, ρ etc.
- Domain of **classical thermodynamics**.

Microscopic

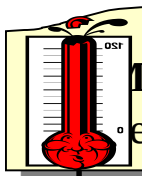
- Considers the detailed **molecular nature** of the system.
- The system is described by a huge number of variables (specify at least the coordinates and the momenta of the molecules)
- Domain of **statistical and quantum mechanics**.



Road Map to Thermodynamics



Road Map to Concepts



Measurable (observable) quantities
Temperature, pressure, density, heat capacity, composition

Abstract (conceptual) quantities
Enthalpy, entropy, chemical potential, fugacity

t (product, outcome)

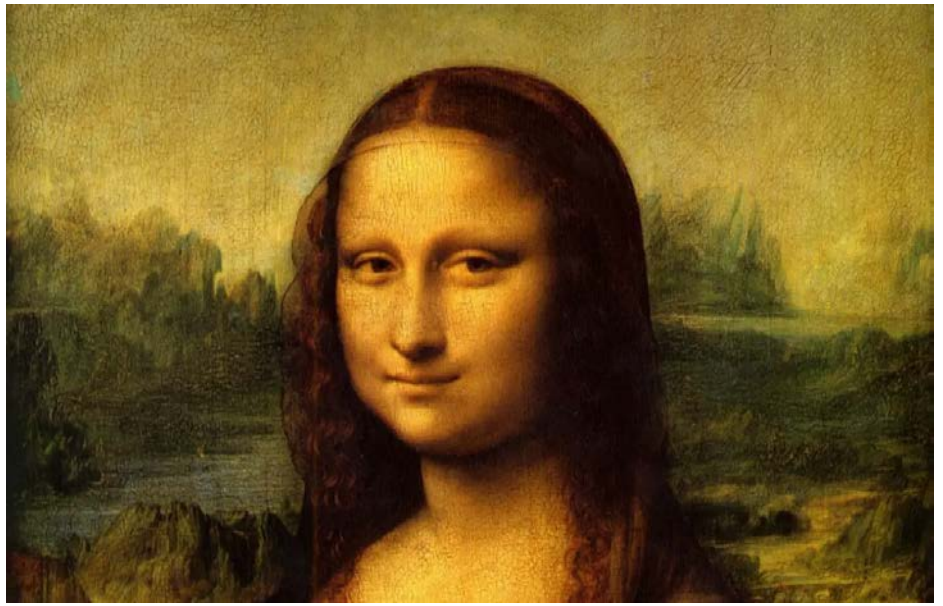
Energy flow

- **Required heat**
- **Required work**
- **Change in state**

Equilibrium

- **Chemical equilibria**
- **Phase equilibria**
- **Combined phase & chemical eqm.**

Guernica
Pablo Ruiz Picasso (25 October 1881 – 8 April 1973)



Mona lisa
Leonardo da Vinci (15 April 1452 – 2 May 1519)

Applications of Thermodynamics