Introduction to thermodynamics

http://courses.cc.iitm.ac.in:8900
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Property

Quantum mechanics
Statistical mechanics
Thermodynamics

Variation of heat with process

Variable Time

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What is unique about Thermodynamics?

Independent of atomic and molecular theory.

In chemical systems, thermodynamics helps to keep a record of energy flow.

Equilibrium state of a chemical system can be understood from thermodynamics.

It is a logical science, three statements describe thermodynamics; deductions from these laws constitute the equations.

Validity of thermodynamic laws depends only on the basic laws and the logical deductions which follow from them.

Since thermodynamics is itself a science, not dependent upon the foundations of other branches, it has an existence of its own.
A theory is the more impressive the greater the simplicity of its premises, the more different kinds of things it relates, and the more extended its area of applicability. Hence the deep impression that classical thermodynamics made upon me. It is the only physical theory of universal content concerning which I am convinced that, within the framework of the applicability of its basic concepts, it will never be overthrown.

Albert Einstein
1. Chemical thermodynamics
2. Statistical thermodynamics
3. Kinetics
4. Surface science

Books:

Lecture schedule
Tutorials
Evaluation

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It is all about heat….

Galileo Galilei 1564-1642

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Francis Bacon 1561-1626 Joseph Black, 1728 - 1799
James Prescott Joule 1818-1889

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Sadi Carnot 1796-1832

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Rudolf Clausius 1822 - 1888
Ludwig Boltzmann 1844-1906
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Jacobus Henricus van 't Hoff 1852-1911

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Walther Hermann Nernst 1864 - 1941

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System

Surroundings

Characterization of a system
Based on properties
(1) intensive properties and (2) extensive properties

Types of systems
(1) open, (2) closed, and (3) isolated systems. 
(1) homogeneous or (2) heterogeneous

Chemical system
Phase, Component

Process, Path
State function, Path function
Exact and inexact differentials
Work, heat
Exothermic, endothermic

First Law

\[ dU = dq - dw \]
Internal energy of an isolated system is constant

\[ \text{Work} = -P_{ex}dV \]
Free expansion = 0
Isothermal work = \( \int -\left(\frac{nRT}{V}\right) dV = -nRT \ln \frac{V_f}{V_i} \) (reversible)

Indicat or diagram
James Watt

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Enthalpy, $H = U + PV$
Calorimetry
Isotherm and adiabat

Thermochemistry
Heat of formation, $\Delta_r H^\circ$

Hess’s Law

Born-Haber Cycle

Kirchhoff’s equation
$\Delta_r H^\circ (T_2) = \Delta_r H^\circ (T_1) + \int \Delta_r C_p^\circ \, dT$

Joule-Thomson Experiment
$
\mu = (\partial T/ \partial P)_H
$

Equipartition principle

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