Topic 1: Applications and concepts of Thermodynamics

Relevant course: Thermodynamics / Engineering Thermodynamics / Thermal Science

Relevant Department: Mechanical Engg., Aerospace Engg., Production Engg.,

Relevant Semester: This is for a beginning course which is typically offered in the 2nd,3rd or 4th semesters of the B.Tech. program.

Pre-requisite: None. A course in Physics that covers thermodynamics would be helpful.

Topic Description:

Session 1 –

Real life examples – Maps, video, pictures, statistics

Applications

- Propulsion: Internal combustion engine, gas turbine, rocket, nuclear plant

- Power generation: Nuclear, Solar, Geothermal, Ocean thermal, Gas turbine, ICE

- Fuel cell, battery

- Refrigeration, Air-conditioning, Cryogenics

- Reactions, Combustion, Metals processing,

- Biological applications

Environmental impact

- Greenhouse effect; Greenhouse Gases (GHG), Climate change

- Ozone layer depletion

- Smog, air quality

- Natural resources (coal, oil) depletion

What do we want to know? What is the process of answering these questions? Interpreting 'answers'?

Laws of Nature (Physics) + methodology for applying them.

Thermodynamics in Physics, Chemistry, Chemical engg., Aero-, ++

Apply Laws to a System that interacts with the Surroundings; System boundary.

Session 2 –

Concepts – their importance, necessity and clarity. The Continuum. Working substance.

System, System boundary, Surroundings - representation in sketches/drawings; What is included.

Thermodynamic concept of Heat, and Work. Examples of each.

Reservoir concept.

Open system. Closed system.

Mass crossing system boundary (not electrons, or photons! Coal, oil, blood?). Mass flow (rate) vs. mass transfer – difference; Diffusion? Steady (state) flow.

Energy crossing system boundary. Work done at system boundary.

Examples of system boundary – 'best', 'optimal', 'convenient'; mass and(or) energy transfer

Session 3 –

State – defined by Properties. Uniform / non-uniform state.

Properties

- extensive; total; units
- intensive; specific property; units

Microscopic approach (kinetic theory, 'nano',).

Macroscopic approach (molecules/atoms together as an 'element').

Equilibrium; Non-equilibrium; Quasi-equilibrium. (state) (system) (relation to surroundings).

Change of state. Sequence (series) of states (of a system) – Path, Process; Cycle. (cyclic device)

(Time) Rate of change of state – Static vs. Quasi-static.

Process – Reversible; Irreversible; Quasi-reversible.

Path function; Point function.