Thermodynamics 1

1. **Course number and name:** 020TH1CI2 Thermodynamics 1

2. **Credits and contact hours:** 6 ECTS credits, 3 x1:15 contact hours

3. **Name(s) of instructor(s) or course coordinator(s):** Sami Youssef

4. **Instructional materials:** course handouts; textbook; slides; in-class problems

5. **Specific course information**
   a. **Catalog description:**
   This course focuses on the laws governing the macroscopic properties of a pure substance by covering fundamental concepts such as work, heat, and temperature. It is in this course that the student understands, describes, and quantifies the operation of thermodynamic machines such as engines, refrigerators, and heat pumps.

   b. **Prerequisites:** None

   c. **Required/Selected Elective/Open Elective:** Required

6. **Educational objectives for the course**
   a. **Specific outcomes of instruction:**
   - To be able to understand the basic concepts of thermodynamics such as macroscopic and microscopic scales, system, equilibrium, thermodynamics parameters, state function, pressure and temperature.
   - To be able to use the equation of state of an ideal gas.
   - To be able to state the first law of thermodynamics and to describe energy exchange processes in terms of various forms of energy, heat and work.
   - To be able to state the second law of thermodynamics, to evaluate entropy changes in a wide variety of transformations and determine the reversibility or irreversibility of a process.
   - To be able to describe transitions between solid, liquid and gaseous sates of matter and to analyze the most important features of a phase diagram.
   - To be able to quantify the efficiency and properties of thermodynamic cycles for heat engines, refrigerators and heat pumps.

   b. **PI addressed by the course:**

PI	1.3	7.1
Covered	x	x
Assessed	x	

7. Brief list of topics to be covered

- States of matter, length scales, mean free path, Maxwell-Boltzmann distribution (homogeneity and isotropy), root-mean-square velocity (3 lectures)
- Thermodynamic system, equilibrium, state function, ideal gas, internal energy, heat capacity at constant volume (6 lectures)
- Thermodynamic processes, first law of thermodynamics, work, heat, enthalpy, heat capacity at constant pressure (5 lectures)
- Quasi-static processes of an ideal gas, Carnot cycle, Joule expansion (3 lectures)
- Irreversibility, second law of thermodynamics, entropy (4 lectures)
- Applications of the second law (6 lectures)
- Thermodynamic description of a phase transition (4 lectures)
- Gas liquefaction, Andrew's isotherms, saturation curve, state functions of vapor-liquid equilibrium (3 lectures)
- Heat engines, refrigerators, heat pump (8 lectures)