

# COURSE OUTLINE

## Heat and Thermodynamics– Spring 2023

### PHYS-234

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#### COURSE OBJECTIVES

Thermal physics is one of the key advanced undergraduate physics courses. It connects the world of everyday systems, of astronomical objects, and of chemical and biological processes with the world of molecular, atomic, and electronics systems. The course will be introduced through a unified approach to the equilibrium thermal properties of large systems based on the quantum viewpoint and statistical probability. The laws of thermodynamics and the concepts of entropy, temperature, chemical potential, free energy, and thermodynamic potential will be covered. The heat transfer, phase transition, and classical kinetic theory will be discussed.

#### LEARNING OUTCOMES

At the end of the course:

1. The student should have a firm grasp of fundamental principles of thermal physics. Students should be able to simplify and model real systems in a physically reasonable and tractable fashion.
2. Utilize the formal and mathematical techniques learnt in the course to predict various properties of the system at hand.
3. Be able to then verbally and in writing communicate what their predictions mean in a real laboratory or natural setting.
4. They should also have a good understanding of the various theoretical techniques of thermodynamics and basic statistical mechanics and be able to identify relevant techniques to address specific physical problems.

#### COURSE OUTLINES

A statistical approach to thermodynamics, thermal and chemical equilibrium, classical and expanding gas heat engines, phase transition and irreversible processes.

## Prerequisites

PHYS 221 (Electricity and Magnetism)

### Course Materials:

- **Text Book:** C. B. P Finn, Thermal Physics
  1. *Concepts in Thermal Physics*, Stephaeen J.Blundell and Katherine M.Blundell
  2. *An introduction to Thermodynamics, The kinetic Theory of Gases and Statistical Mechanics*, Francis Weston Sears, 2<sup>nd</sup> Edition
  3. physical chemistry by Silbey, 4<sup>th</sup> Edition.

**Course grading:** Your final grade will be based on the following:

Assignments + Quizzes + Class Participation+ Presentations	50%
Midterm Test	25%
Final Examination	25%
	100%

### **Syllabus and Tentative schedule:**

<b>Week</b>	<b>Learning Activity</b>	<b>Quiz-Assignments</b>
<b>1</b>	Brief Survey of Thermodynamic systems, Symbols and units	Pre knowledge quiz

<b>2-3</b>	Further preliminary aspects of thermal physics, Simple thermodynamic systems, Reversible Processes, Zeroth Law of thermodynamics	Assignment 1
<b>4</b>	The first law of thermodynamics and its consequences and applications	Quiz
<b>5</b>	Kinetic Theory of gasses	
<b>6</b>	The second law of thermodynamics and the concept of entropy	Quiz Assignment 2
<b>7</b>	The thermodynamic potentials	
<b>8</b>	Enthalpy and Gibbs Function	Mid Term Exam
<b>9</b>	Heat Capacity	Quiz
<b>10</b>	Phase Changes	Presentation of team based project 1 Assignment 3
<b>11</b>	Chemical Potential	Quiz
<b>12</b>	The third law of thermodynamics	Presentation of team based project 2
<b>13-14</b>	Free energy and Applications of thermodynamics	Assignment 4