

# PHY3290: THERMODYNAMICS

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## Effective Term

Semester A 2025/26

## Part I Course Overview

### Course Title

Thermodynamics

### Subject Code

PHY - Physics

### Course Number

3290

### Academic Unit

Physics (PHY)

### College/School

College of Science (SI)

### Course Duration

One Semester

### Credit Units

3

### Level

B1, B2, B3, B4 - Bachelor's Degree

### Medium of Instruction

English

### Medium of Assessment

English

### Prerequisites

PHY1101 Introductory Classical Mechanics or  
PHY1201 General Physics I\*

### Precursors

MA2158 Linear Algebra and Calculus

### Equivalent Courses

Nil

### Exclusive Courses

MSE3190 Thermodynamics of Materials AP3290 Thermodynamics

### Additional Information

\* This pre-requisite requirement is waived for Advanced Standing I students (admitted in 2015/16 and thereafter) and Advanced Standing II students.

## Part II Course Details

### Abstract

To develop a basic understanding in elementary concepts of thermodynamics. To understand the laws of thermodynamics, property relationships and equilibrium of thermodynamics systems.

### Course Intended Learning Outcomes (CILOs)

CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	State the laws of thermodynamics.		x	
2	Identify thermodynamic cycles and apply the principle to a heat engine.		x	
3	Recognize the thermodynamic property relationships.		x	
4	Describe the equilibrium of a thermodynamic system.		x	
5	Explain basic statistic thermodynamics theory.		x	

#### A1: Attitude

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

#### A2: Ability

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

#### A3: Accomplishments

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

### Learning and Teaching Activities (LTAs)

LTAs	Brief Description	CILO No.	Hours/week (if applicable)	
1	Lecture/Tutorial	Explain and discuss the key concepts about laws of thermodynamic, thermodynamic relationships, single component phase equilibria and statistical thermodynamics	1, 2, 3, 4, 5	39
2	Laboratory	To demonstrate all the ley concepts learned in the lecture and tutorial sessions by experimentation	1, 2, 3, 4, 5	10

### Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Test	1, 2, 3, 4, 5	20	There will be one mid-term test	No
2	Lab reports	1, 2, 3, 4, 5	10	Students need to complete a number of experiments that demonstrate the principles discussed in lectures/tutorials	Yes
3	Assignment	1, 2, 3, 4, 5	10	Take-home or in-class assignments.	Yes

**Continuous Assessment (%)**

40

**Examination (%)**

60

**Examination Duration (Hours)**

2

**Minimum Examination Passing Requirement (%)**

30

**Additional Information for ATs**

For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained

**Assessment Rubrics (AR)****Assessment Task**

1. Test

**Criterion**

Able to solve numerical problems, and demonstrate the understanding of basic principles

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not even reaching the marginal level

**Assessment Task**

2. Lab reports

**Criterion**

Ability to explain the methodology and results from experiments

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not even reaching the marginal level

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**Assessment Task**

3. Assignment

**Criterion**

Able to solve numerical problems, and demonstrate the understanding of basic principles

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not even reaching the marginal level

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**Assessment Task**

4. Examination

**Criterion**

Able to solve numerical problems, and demonstrate the understanding of basic principles

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not even reaching the marginal level

## Part III Other Information

### Keyword Syllabus

- Introduction and the 1st laws of thermodynamics  
Systems and surroundings, energy transfer, internal energy, heat, work, temperature, enthalpy, steady state, heat capacities, thermal expansion, first law of thermodynamics, constant volume process, cyclical process, adiabatic process, free expansion process.
- The 2nd law of thermodynamics and heat engines  
Second law of thermodynamics, heat engine, thermo efficiency, refrigerators, coefficient of performance, reversibility and irreversibility, Carnot engine, entropy, isentropic processes.
- Property relationships  
Thermodynamic relations, Maxwell relations, specific heat, Mayer relation, general relations, Clapeyron equation, Clapeyron-Clausius equation.
- Equilibrium  
Thermodynamic equilibrium, phase equilibrium, phase rule, phase equilibrium for a multi-component system, chemical equilibrium, equilibrium constant for ideal-gas mixtures.
- Applications  
Analyze all processes in a vapor power system, gas power system, refrigeration and heat pump systems and calculate their performance
- Statistical thermodynamics  
Macrostates and microstates, Boltzmann distribution, distinguishability of particles, Maxwell-Boltzmann distribution, indistinguishability of particles, Maxwell speed distribution for gas molecules, Fermi-Dirac distribution, mean free path, diffusion in gases.

### Reading List

#### Compulsory Readings

Title	
1	Lecture slides (will be distributed during the lecture sessions)
2	Tutorial slides (will be distributed during the tutorial sessions)

#### Additional Readings

Title	
1	Michael Moran, Howard N. Shapiro, Daisie D. Boettner, Margaret B. Bailey, Fundamentals of Engineering Thermodynamics, 8th Edition Wiley
2	Yunus A Cengel, Michael A Boles, "Thermodynamics: An Engineering Approach," 5th Ed., McGrawHill.
3	David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of Physics," 7th Ed., John Wiley & Sons.