School of Engineering and Physical Sciences
Department of Mathematics and Physics

Course Name	Thermal Physics
Course Code	PHY 260
Course Credit Hours	3
Prerequisite	PHY107 and MAT 130
Course Objective	The objective of this course is to develop a working knowledge of the laws and methods of thermodynamics and elementary statistical mechanics.
Course Description	Thermal physics is concerned with the study of macroscopic and mesoscopic systems. In this course, students learn the properties and processes that occur in such systems. Topics to be covered include: Classical thermodynamics. Kinetic theory of gases, ideal gas, van der Waals gas. First law of thermodynamics. Heat engines, Carnot cycle, Carnot's theorem. Classical entropy, Second law of thermodynamics, Third law of thermodynamics, Postulate approach to classical thermodynamics, fundamental relation and its consequences. Thermodynamic probability, Boltzmann entropy, Boltzmann distribution. The syllabus will be illuminated with examples from biology, industry, climate and the environment.
Method(s) of Instruction(s)	Interactive lectures and simulations

COURSE CONTENT BY TOPIC

Module #1	**Nature of Thermodynamics:** Kinetic theory of gases, Ideal gas, Temperature, Thermal equilibrium: Zeroth Law of thermodynamics, Kelvin scale of temperature
Module #2	**Equations of State:** Equation of state of an Ideal gas, Van der Waal's Equation for a Real Gas, P-v-T surfaces for real substances, Expansivity & Compressibility, Landau Theory of Phase
Module #3	**First law of Thermodynamics & Applications:** Work and energy, Enthalpy and Heats of Transformation, Heat engines, Carnot cycle.
Module #4	**Second law of Thermodynamics & Applications:** Entropy, Reversible and irreversible process, Carnot theorem, Clausius inequality and second law, Temperature -Entropy Diagram
Module #5	**Thermodynamic Potentials:** Legendre transformation, Maxwell and TdS relations, Constant temperature situations, Helmholtz free energy, Gibb's function, Free energy as a force toward equilibrium, Extremal principle
Module #6	**Third Law of Thermodynamics:** Statement of the third law, Method of cooling, Determination of free energy and applications to simple systems
Module #7	**Applications (Mainly the Ideal Gas) :** Equipartition of energy, Heat capacity at constant V and constant P relationship, Ideal gas: adiabatic compression, free expansion., Joule-Thompson process, gas liquefaction, Entropy of mixing and indistinguishability, Reversible and irreversible processes
Module #8	**Introduction to Statistical Mechanics** Statistical description of many-body systems; Formulation as a probability distribution over microstates, Central limit theorem and macrostates, Statistical mechanical formulation of entropy
Actual contact hours: Lecture: 3 hours per week; 36 hours per semester	

TEXTBOOK REQUIREMENT

1. Classical and Statistical Thermodynamics, Ashley H. Carter
2. An Introduction to Thermal Physics, Daniel V. Schroeder
3. Statistical and Thermal Physics, M. J. Hoch

ASSESSMENT STRATEGY AND GRADING SCHEME

NSU's grading and performance evaluation policies will be followed in assigning your grade. Please note that all final grades are subject to departmental review and approval. A guideline of course assessment is as follows-

Class Attendance	Assignments	Quiz	Midterm	Final
5%	10%	20%	30%	35%

MAPPING OF COURSE OUTCOMES

CLO-#	Outcome Types	Bloom's Taxonomy level (C- Cognitive, A- Affective, P- Psychomotor)	Delivery Method	Assessment Tools	
CLO #1	Understand the effect of temperature on the random motion of particles.	C2, P2	Lecture and discussion	Assignment and Quiz	Midterm Exam
CLO #2	Describe the state of matter under a given set of physical conditions, such as pressure, volume, temperature, or internal energy.	C2, P2	Lecture and discussion	Assignment and Quiz	
CLO #3	Understand different thermodynamic state functions.	C2, P2	Lecture and discussion	Assignment and Quiz	
CLO #4	Apply the concept of entropy to predict the direction of thermal processes.	C3, P3	Lecture and discussion	Assignment and Quiz	
CLO #5	Analyze the thermodynamic state of a system with four fundamental functions: internal energy U, enthalpy H, Helmholtz free energy F, and Gibbs free energy G.	C4, P3	Lecture and discussion	Assignment and Quiz	Final Exam
CLO #6	Apply the laws of thermodynamics to solve problems in thermodynamic systems such as gases.	C3, P2	Lecture and discussion	Assignment Quiz, In-class workshop	