Tsuyama College	Year	2020	Course Title	Introduction to Thermodynamics

Course Information

Course Code	0053	Course Category	General / Compulsory
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Integrated Science and Technology Communication and Informations System Program	Student Grade	3rd
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	Textbook : A. Kinbara et al., "Senmonkiso Library Netsurikigaku Jirei de Wakaru Kanngaekata to Tsukaikata" (Jikkyo Shuppan).Reference book : M. Matsushita, "Lecture on Physics Thermodynamics" (Shokabo).		
Instructor	SAEKI Fumihiro,SEKI Ichiro		

Course Objectives

Learning purposes :
Learn fundamental knowledge of heat and energy, and understand roles of heat in nature and engineering.

Course Objectives :
1. To explain the basic concepts of thermodynamics and related physical quantities.
2. To understand the first law of thermodynamics, and calculate energy exchange in state change.
3. To understand the properties of ideal gas, and calculate heat, work, and quantity of state in state change.
4. To understand the second law of thermodynamics, and explain characteristics of familiar phenomena and heat engines.
5. To calculate the thermal efficiency of a heat engine.

Rubric

	Excellent	Good	Acceptable	Not acceptable
Achievement 1	Understand the basic concepts of thermodynamics and the definitions, units, and properties of related physical quantities. Express them accurately using symbols and mathematical expressions.	Understand the basic concepts of thermodynamics and the definitions, units, and properties of related physical quantities.	Understand the definitions and units of physical quantities related to thermodynamics.	Has not reached the level described in the columns on the left.
Achievement 2	Accurately explain and calculate energy exchange in various state changes using a consistent representation of the first law of thermodynamics.	Calculate energy exchange in various state changes using the first law of thermodynamics.	Calculate energy exchange using the first law of thermodynamics.	Has not reached the level described in the columns on the left.
Achievement 3	Understand the properties of ideal gas, and derive the equations for state change.	Calculate energy exchange and quantity of state using equations for state change of ideal gas.	Calculate the quantity of state using the equation of state of ideal gas.	Has not reached the level described in the columns on the left.
Achievement 4	Understand the second law of thermodynamics, and explain the difference between an ideal state change and a real state change.	Explain the characteristics of familiar phenomena and devices in terms of the second law of thermodynamics.	Illustrate a familiar irreversible process.	Has not reached the level described in the columns on the left.
Achievement 5	Explain the Carnot cycle, and derive its thermal efficiency.	Calculate the thermal efficiency of general and Carnot heat engines.	Explain the definition of thermal efficiency of a heat engine.	Has not reached the level described in the columns on the left.

Assigned Department Objectives

Teaching Method

Outline	General or Specialized : General Field of learning : Common and basic natural science Required, Elective, etc. : Must complete subjects Foundational academic disciplines : Physics, Mechanical engineering/Thermal engineering Relationship with Educational Objectives : This class is equivalent to "(2) Acquire basic science and technical knowledge". Relationship with JABEE programs : The main goal of learning / education in this class is "(A)". Course outline : This course corresponds to the study of basic science and aims to cultivate scientific thinking. The conversion of heat and work, and changes in the state of matter are explained, taking into account familiar examples and their relation to engineering technology.
Style	Course method : The class will be taught mainly on the board, with careful explanations of basic concepts as much as possible. This is a course offered only in the second semester. Grade evaluation method : Exams (80%) + Homework (20%). The grades of the two regular examinations will be evaluated equally. Textbooks and notebooks are not allowed in the exam. Students whose grades are less than 60 points are re-tested, where the grade is re-evaluated up to 60 points by using the average of the regular and re-test scores. The eligibility of re-test is determined based on the student's learning attitude.

Notice	Precautions on the enrollment : This must be completed (the number of hours missed may not exceed one third of the total number of class hours) in order to complete the course. Course advice : Thermodynamics is one of the most important subjects in natural science and engineering. It is desirable to understand the contents of the basic subjects listed below. Foundational subjects : Physics I (1st year), Physics II (2nd), Differential and Integral I (2nd), Differential and Integral II (3rd) Related subjects : Mechanics I, II, III (3rd year) Attendance advice : It is important to understand by building up knowledge rather than by memorizing. Deepen your understanding by doing your homework actively. Arriving (leaving) more than 20 minutes late (early) will result in one absence, and arriving (leaving) more than 65 minutes late (early) will result in two absences.

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Guidance Basic concepts of thermodynamics (temperature and heat)	Explain the relationship between thermal motions of atoms and molecules and absolute temperatures.
		2nd	Basic concepts of thermodynamics (quantity of state, quantity depending on a process)	Explain that the state reaches thermal equilibrium by heat transmission as time passes. Perform calculations using heat capacity and specific heat of objects. Write a formula representing the law of conservation of heat then calculate heat capacity and specific heat.
		3rd	The first law of thermodynamics (energy conservation, internal energy)	Explain the internal energy of gas. Explain the first law of thermodynamics. Explain that energy takes various forms and can be converted between each form, showing specific examples.
		4th	The first law of thermodynamics (heat capacity, specific heat capacity, enthalpy)	Calculate the enthalpy of closed system. Explain the relationship between specific heat at constant volume, specific heat at constant pressure, specific heat ratio and gas constant. Explain the relationship between the variation and temperature of internal energy and enthalpy.
		5th	Properties of ideal gas (equation of state, specific heat capacity)	Perform calculations relating to pressure, temperature and volume of gas using Boyle-Charles' law and the equation of state for the ideal gas.
		6th	Quasi-static process of ideal gas (isobaric change, isochoric change)	Explain isochoric and isobaric changes of ideal gas. Calculate physical properties in isochoric and isobaric changes using the equation of state of ideal gas.
		7th	Quasi-static process of ideal gas (isothermal change)	Explain isothermal change of ideal gas. Calculate physical properties in isothermal change using the equation of state of ideal gas.
		8th	2nd semester mid-term exam	
	4th Quarter	9th	Return and commentary of exam answers	
		10th	Quasi-static process of ideal gas (reversible adiabatic change)	Explain reversible adiabatic change of ideal gas. Calculate physical properties in reversible adiabatic change using the equation of state of ideal gas.
		11th	Mixture of ideal gas(Dalton's law, quantity of state)	Explain the Dalton's law. Calculate quantities of state of a gas mixture.
		12th	Microscopic model of ideal gas (motion of gas molecules)	Explain the relationship between thermal motions of molecules and properties of ideal gas.
		13th	The second law of thermodynamics (irreversible process, heat engine, thermal efficiency)	Explain that work performed by kinetic friction force generally turns into heat. Show specific examples of irreversible changes. Perform calculations relating to thermal efficiency of heat engines.
		14th	The second law of thermodynamics (Carnot cycle)	Understand the meaning of a cycle, and calculate the thermal efficiency of a thermal engine. Understand the change in state of the Carnot cycle and calculate thermal efficiency.
		15th	(2nd semester final exam)	
		16th	Return and commentary of exam answers	

Evaluation Method and Weight (%)

	Examination	Report	Total
Subtotal	80	20	100
Basic Proficiency	80	20	100
Specialized Proficiency	0	0	0
Cross Area Proficiency	0	0	0