Akashi College	Year	2022	Course Title	Energy Technology I

Course Information

Course Code	4022	Course Category	Specialized / Elective
Class Format	Lecture	Credits	Academic Credit: 2
Department	Mechanical and Electronic System Engineering	Student Grade	Adv. 1st
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials			
Instructor	FUJIWARA Seiji		

Course Objectives

The goal is to be able to understand and calculate the following for the numerical analysis of heat fluids in energy engineering.
(1) Understand the basic equation of heat fluid analysis.
(2) Understand the discretization method of basic equations.
(3) Understand the HSMAC method.
(4) Set a problem and perform simulations on one's own.
(5) Present answers to one's own problem through presentations.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Fully understand and can derive the basic equations for heat fluid analysis.	Understand the basic equations for heat fluid analysis.	Do not understand the basic equations for heat fluid analysis.
Achievement 2	Understand the discretization method of basic equations and can derive them on its own.	Understand the discretization method of basic equations.	Do not understand the discretization method of basic equations.
Achievement 3	Understand the HSMAC method and can program it on one's own.	Understand the HSMAC method.	Do not understand the HSMAC method.
	Can set a problem, perform simulations, and analyze data on one's own.	Can set a problem and perform simple simulations on one's own.	Cannot set a problem and perform simple simulations on one's own.
	Can clearly present the answers to one's own problem in English in an easy-to-understand presentation.	Can present the answers to one's own problem in a presentation.	Cannot present the answers one's own problem in a presentation.

Assigned Department Objectives

Teaching Method

Outline	In general energy equipment, power is taken from fluid motion by turbines, etc. and converted to electrical energy through generators. In addition, how the movement of water and electrolytes is controlled has a major effect on performance in fuel cells, etc. In developing energy equipment, numerical analyses of heat fluid are widely conducted with the aim of reducing development costs and obtaining detailed data. In this course, students will learn about the HSMAC method, which is one of the methods to numerically analyze heat fluid, and learn how to analyze incompressible fluids.
Style	The first half of the class is made up of lecture-style sessions. In the second half, students will conduct exercises while discussing important matters related to energy engineering.
Notice	This course's content will amount to 90 hours of study in total. These hours include the learning time guaranteed in classes and the standard self-study time required for pre-study / review, and completing assignment reports. While it is desirable for students to have a basic knowledge of fluid dynamics and thermodynamics, thorough reviewing of the lessons will help students understand the content. Furthermore, students need to have a minimum knowledge of C language. In addition, this course will fundamentally be conducted in English. Students who miss 1/3 or more of classes will not be eligible for a passing grade.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Basic equations for heat fluid simulation (1)	Understand the equations of the fluid continuum and the derivation of equations of motion.
		2nd	Basic equations for heat fluid simulation (2)	Understand the derivation of fluid equations of motion and equations of energy.
		3rd	Basic equations for heat fluid simulation (3)	Can convert the energy equation of fluid to one for uncompressed fluid. Also, understand the method of the Boussinesq approximation as a treatment of buoyancy terms.
		4th	About nondimensionalizing basic equations	Understand the significance of nondimensionalizing basic equations, and how to make it dimensionless.
		5th	Discretization method of basic equations (1)	Understand how to discretize differential equations that are basic equations. Also, understand the solution's accuracy and the stability conditions.

		6th	Discretization method of basic equations (2)	Understand how to discretize differential equations that are basic equations. Also, understand the solution's accuracy and the stability conditions.
		7th	MAC method, and SMAC method	Can derive Poisson's equation on pressure, and understand the MAC and SMAC methods, which are two of the explicit methods for incompressible fluid.
		8th	HSMAC method	Understand the HSMAC method to solve the Poisson's equation on pressure using Newton's method.
	4th Quarter	9th	Explanation of assignment 1	Can create a vector diagram using free software as an example of a flow in a cavity containing thermal convection.
		10th	Exercise	Can calculate the heat transfer coefficient from the analysis results.
		11th	Exercise	Understand the relationship between mesh refinement and analysis accuracy.
		12th	Explanation of assignment 2	Can review the engineering problems on one's own, and can discuss the problems proposed with teachers and set an appropriate problem.
		13th	Exercise	Can program and run simulations for the problem on one's own.
		14th	Exercise	Can program and run simulations for the problem on one's own.
		15th	Presentation	Can present simulation results for the problem in English.
		16th	No final exam	

Evaluation Method and Weight (%)

	Examination	Presentation	Assignments	Behavior	Portfolio	Other	Total
Subtotal	0	30	70	0	0	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	0	30	70	0	0	0	100
Cross Area Proficiency	0	0	0	0	0	0	0