Akashi College	Year	2023	Course Title	Optimization Design

Course Information

Course Code	5037	Course Category	Specialized / Elective
Class Format	Lecture	Credits	Academic Credit: 2
Department	Mechanical and Electronic System Engineering	Student Grade	Adv. 2nd
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials			
Instructor	SHI Fenghui		

Course Objectives

(1) Understand and learn about the knowledge and methods for optimization and optimal design.
(2) Understand and can calculate basic mathematical formulas for linear and nonlinear programming optimization techniques.
(3) Understand the concepts and mathematical expressions of multi-objective optimization.
(4) Can explain and practice the principles of optimal design for genetic algorithms.
(5) Can create the optimal design for a helical gear reducer as an example of optimal design, and apply the optimization.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Understand and fully learn about the knowledge and methods for optimization and optimal design	Understand and learn about the knowledge and methods for optimization and optimal design	Do not understand and learn about the knowledge and methods for optimization and optimal design
Achievement 2	Understand and can fully calculate the basic mathematical formulas for linear and nonlinear programming optimization techniques.	Understand and can calculate basic mathematical formulas for linear and nonlinear programming optimization techniques.	Do not understand and cannot calculate basic mathematical formulas for linear and nonlinear programming optimization techniques.
Achievement 3	Fully understand the concepts and mathematical expressions of multi-objective optimization	Understand the concepts and mathematical expressions of multi-objective optimization	Do not understand the concepts and mathematical expressions of multi-objective optimization
	Fully understand the idea of genetic algorithms and mathematical expressions	Fully understand the idea of genetic algorithms and mathematical expressions	Fully understand the idea of genetic algorithms and mathematical expressions
	Can program and calculate the optimal design for a helical gear reducer	Can program and calculate the optimal design for a helical gear reducer	Can program and calculate the optimal design for a helical gear reducer

Assigned Department Objectives

Teaching Method

Outline	Optimization (which covers a wide range of fields) and optimal design (which covers design fields) are being actively used in a variety of fields in response to the demand for higher performance in mechanical systems. As computers continue to develop, the importance of optimization and optimal design is expected to increase in the future. In this course, students will learn about the concepts and processes of optimization and optimization design and optimization techniques. They will also learn specific examples of optimal design for various machine systems. Quizzes will be carried out to ensure knowledge.
Style	Classes will be held in a lecture style. There will be assignments as appropriate.
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. Students who miss 1/3 or more of classes will not be eligible for evaluation.

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	Course guidance	Explain the course content in accordance with the syllabus
		2nd	Optimization concepts and terminology	Explain concepts, terminology, and techniques of optimization through examples of optimal design, and optimization and optimal design problems.
		3rd	Optimization methods using Optimization Toolbox (Matlab) Learn the basic operations of Matlab/Simulink and Optimization Toolbox for calculating optimization.	How to use MATLAB/Simulink and Optimization Toolbox
		4th	Linear programming optimization (1)	An outline of linear programming optimization problems and formulation methods.
		5th	Linear programming optimization (2)	Simplex method and examples of its application.
		6th	Linear programming optimization (3)	Example applications of linear programming methods. Linear programming optimization using Matlab's Optimization Toolbox.

		7th	Nonlinear programming optimization (1)	An overview of non-linear optimization problems and optimization techniques. Explain application examples of nonlinear programming in engineering and unconstrained optimization techniques.
		8th	Nonlinear programming optimization (2)	Learn about modeling, formulation, preprocessing, optimization calculation programs, and examination of optimization results.
	4th Quarter	9th	Nonlinear programming optimization (3)	Genetic algorithms (GA) Learn an overview for genetic algorithms and the contents of an optimal solution search program. Take design examples and compare them with other optimization techniques. Explain constrained optimization techniques and learn SUMT, linear minimization techniques, and Powell's conjugate direction method.
		10th	Multi-objective optimization Report 1: Multi-objective optimization of new bus routes (1)	Learn about the weighted method for the multi-objective optimization method. Take application examples to learn how to do multi-objective optimization in the exercise.
		11th	Report 1: Multi-objective optimization of new bus routes (2)	Plan a new bus route to maximize customer satisfaction and profit for the bus operator using multi-objective optimization. Multi-objective optimization using Matlab's Optimization Toolbox.
		12th	Report 2: Optimal designs for helical gear reducers (1)	Use the gear design knowledge learned in Engineering Design and Design and Drawing, and create the optimal design for a helical gear reducer.
		13th	Report 2: Optimal designs for helical gear reducers (2)	Formulate methods for objective functions, design variables, and constraints.
		14th	Report 2: Optimal designs for helical gear reducers (3)	Promote Matlab programming creation (M-files). Study the optimization results, compare them with the computation results done in this course, and recognize the importance of optimal design.
		15th	Summary and evaluation	Summarize and review the content learned on this course.
		16th	Final exam	

Evaluation Method and Weight (%)

	Examination	Exercise&Report	Total
Subtotal	40	60	100
Basic Proficiency	30	30	60
Specialized Proficiency	10	20	30
Cross Area Proficiency	0	10	10