Akashi College	Year	2022	Course Title	Analytical Mechanics

Course Information

Course Code	4012	Course Category	Specialized / Elective
Class Format	Lecture	Credits	Academic Credit: 2
Department	Mechanical and Electronic System Engineering	Student Grade	Adv. 1st
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials			
Instructor			

Course Objectives

(1) Understand that Lagrangian mechanics are formulated by developing Newtonian mechanics with a focus on the handling of constraints.
(2) Understand the basic concepts of vibration in multi-degree of freedom systems (including continua, which are infinite degrees of freedom systems), with a focus on normal vibration.
(3) Learn the calculus of variations, and understand that the basic laws of mechanics can be formulated as variation principles.
(4) Understand that Hamiltonian mechanics (canonical formulation) is formulated by making the equations of motion, second-order differential equations, into first-order ones.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Fully understand the formulation of Lagrangian mechanics.	Understand the formulation of Lagrangian mechanics.	Do not understand the formulation of Lagrangian mechanics.
Achievement 2	Fully understand the basic concepts of multi-degree of freedom vibration systems.	Understand the basic concepts of multi-degree of freedom vibration systems.	Do not understand the basic concepts of multi-degree of freedom vibration systems.
Achievement 3	Fully understand the formulation of mechanics by variation principles.	Understand the formulation of mechanics by the variation principles.	Do not understand the formulation of mechanics by the variation principles.
Achievement 4	Fully understand the formulation of Hamiltonian mechanics.	Understand the formulation of Hamiltonian mechanics.	Do not understand the formulation of Hamiltonian mechanics.

Assigned Department Objectives

Teaching Method

Outline	Analytical mechanics is the mathematical development of Newtonian mechanics and is one of the important fundamental departments involved in the wide area of engineering. The theory of analytical mechanics is composed of the Lagrangian and Hamiltonian mechanics (canonical formulation). In this course, students will mainly study the Lagrangian mechanics. The Lagrangian mechanics is designed to handle various mechanics problems well. It is also the basis for learning the Hamiltonian mechanics, which is introduced at the end of the semester.
Style	Classes are held in a lecture style.
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. Be aware that class time makes up a small percentage of the overall expected learning time, and students are advised to thoroughly pre-study or review. * Liaison: Ogasawara 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
1st Semester	1st Quarter	1st	The principle of virtual work and d'Alembert's principle	Learn the basics about the principle of virtual work and d'Alembert's principle.
		2nd	The method of Lagrange multipliers	Learn the basics of the method of Lagrange multipliers.
		3rd	Lagrange's equations of motion of the first kind	Learn the basics of Lagrange's motion equations of the first kind.
		4th	Generalized coordinates and generalized velocity	Learn the basics of generalized coordinates and generalized velocity.
		5th	Lagrange's equations of motion (the second kind)	Learn the basics of Lagrange's equations of motion.
		6th	Normal coordinates in a coupled oscillation system	Learn the basics of coupled oscillation systems.
		7th	Normal coordinates in a coupled oscillation system	Learn the basics of coupled oscillation systems.
		8th	Waves	Learn the basics of waves.
	2nd Quarter	9th	Lagrangian formulation for continua	Learn the basics of Lagrangian formulation for continua.
		10th	Calculus of variations and Euler's differential equations	Learn the basics of the calculus of variations and Euler's differential equations.
		11th	Hamilton's principle	Learn the basics of Hamilton's principle.

		12th	Hamilton's canonical equations	Learn the basics of Hamilton's canonical equations.
		13th	Hamilton's canonical equations	Learn the basics of Hamilton's canonical equations.
		14th	Variation principle in Hamiltonian mechanics	Learn the basics of variation principle in Hamiltonian mechanics.
		15th	Summary and supplementary notes	Understand the relationship between Lagrangian and Hamiltonian mechanics.
		16th	Final exam	

Evaluation Method and Weight (%)

	Examination	Exercise	Total
Subtotal	70	30	100
Basic Proficiency	0	0	0
Specialized Proficiency	70	30	100
Cross Area Proficiency	0	0	0