| Akashi College | Year | 2023 | Course Title | Dynamics of Machinery |
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## Course Information

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| Course Code | 5436 | Course Category | Specialized / Compulsory |
| Class Format | Lecture | Credits | Academic Credit: 2 |
| Department | Mechanical Engineering | Student Grade | 4th |
| Term | First Semester | Classes per Week | 2 |
| Textbook and/or Teaching Materials | | | |
| Instructor | SEKIMORI Daisuke | | |

## Course Objectives

(1) Can consider the vibratory system of one and two degrees of freedom based on the equations of motion.
(2) Can find the equations of motion (linear second-level differential equations) against the basic vibration model and understand what kind of physical phenomena the solution represents.
(3) Learn the modeling methods and sensibility, or the analysis process, which are essential for the analysis process.
(4) Can acquire the ability to apply the knowledge they have learned to reduce and prevent vibration and about measurement and instrumentation of vibration, and respond appropriately.

## Rubric

| | Ideal Level | Standard Level | Unacceptable Level |
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| Achievement 1 | Can accurately examine the vibration system with one and two degrees of freedom based on the equations of motion. | Can examine the vibration system with one and two degrees of freedom based on the equations of motion. | Cannot examine the vibration system with one and two degrees of freedom based on the equations of motion. |
| Achievement 2 | Can find the equations of motion (linear second-level differential equations) against the basic vibration model and fully understand what kind of physical phenomena the solution represents. | Can find the equations of motion (linear second-level differential equations) against the basic vibration model and fully understand what kind of physical phenomena the solution represents. | Cannot find what kind of physical phenomena the solution is represented by leading the equations of motion (linear second-level differential equations) to the basic vibration model. |
| Achievement 3 | Accurately learn the modeling techniques, the sense of modeling, or the analysis process that are essential for the analysis process. | Learn the modeling techniques, the sense of modeling, or the analysis process that are essential for the analysis process. | Do not learn the modeling methods and sense of analysis, or the process of analysis, which is essential to the progress of analysis. |
| | Can acquire the ability to apply the knowledge they have learned to reduce and prevent vibration and about measurement and instrumentation of vibration, and respond appropriately. | Can acquire the ability to apply the knowledge they have learned to reduce and prevent vibration and about measurement and instrumentation of vibration, and respond appropriately. | Cannot acquire the ability to apply the knowledge they have learned to reduce and prevent vibration and about measurement and instrumentation of vibration, and respond appropriately. |

## Assigned Department Objectives

## Teaching Method

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| Outline | Identifying the dynamic behavior (vibration) of a machine is essential in the design of a machine. In this lesson, to study the basics of mechanical vibration analysis, students will examine the vibration system with one and two degrees of freedom based on the motion equation. Derive the equations of motion (linear second-level differential equations) against the basic vibration model and consider what kind of physical phenomena the solution represents. |
| Style | Lectures will be given in line with the textbook, and practice problems will be assigned. |
| 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. Since this is one of the few courses in mechanical engineering on dynamics, students are requested to fully learn the basic idea. It is also important to review the knowledge gained in basic subjects such as Maths III A, Maths III B, and Industrial Dynamics I.<br>Students who miss 1/3 or more of classes will not be eligible for evaluation. |

## Characteristics of Class / Division in Learning

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

## Course Plan

| | | | Theme | Goals |
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| 1st Semester | 1st Quarter | 1st | Basics of vibration | Learn basic knowledge of mechanics and mathematics necessary for the analysis of vibration phenomena. |
| | | 2nd | Degrees of freedom and equations of motion | Understand the concept of degrees of freedom. Understand the basics of how to derive the equations of motion based on the Newton's second law. |
| | | 3rd | Non-damping free vibration of one degree of freedom (1) | Learn how to derive equations of motion for non-damping free-vibration systems such as linear and rotational vibration can be studied. Also, understand how to derive the equations of motion in systems that contain multiple springs, plate springs, etc. |

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| | | 4th | Non-damping free oscillation with one degree of freedom (2) | Can standardize the equations of motion of the non-damping free-vibration system and learn the solutions. Understand the behavior of the system and its natural frequencies. |
| | | 5th | Damped free oscillation with one degree of freedom (1) | Understand the principle of dash pot, the damping element . Learn how to derive the equations of motion for damping free-vibration systems such as linear and rotational vibrations can be studied. |
| | | 6th | Damped free oscillation with one degree of freedom (2) | Can standardize the equations of motion for the damping free-vibration system and learn the solutions. Understand the relationship between damping ratio and system behavior. |
| | | 7th | Transient vibration | Understand the transient response of the oscillation system, which is subjected to step-function and impulse-function forces from the outside. |
| | | 8th | Midterm exam | |
| | 2nd Quarter | 9th | One degree of freedom damping force vibration (1) | Learn how to derive the equations of motions for damping force vibration systems such as linear and rotational vibrations. |
| | | 10th | One degree of freedom for damping force vibration (2) | Can standardize the equations of motion of the damping force vibration system and learn the solutions. Understand the frequency response of the system and the forces transmitted to the foundation. |
| | | 11th | One degree of freedom for damping force vibration (3) | Learn how to derive and solve the motion equation of the damping force vibration system by enforced displacement. Understand the principle of a vibration meter, which is an application of the system. |
| | | 12th | 2 degrees of freedom vibration (1) | Understand the concept of coupled vibration by finding the equations of simultaneous motion in models with two degrees of freedom, such as linear and rotational vibration. |
| | | 13th | 2 degrees of freedom vibration (2) | Learn how to solve the equations of motion of coupled free vibration. Understand the reference frequencies and modes that obtained from the frequency equations. |
| | | 14th | Force vibration of two degrees of freedom | Learn how to derive and solve for the equations of motion for coupled forced vibration. Understand the frequency response of a system. |
| | | 15th | Vibration isolation and vibration control | Learn the principle of a dynamic damper consisting of mass and spring, and can examine the reduction and prevention of vibration. |
| | | 16th | Final exam | |

Evaluation Method and Weight (%)

| | Examination | Presentation | Mutual Evaluations between students | Behavior | Portfolio | Exercises | Total |
|---|---|---|---|---|---|---|---|
| Subtotal | 90 | 0 | 0 | 0 | 0 | 10 | 100 |
| Basic Proficiency | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Specialized Proficiency | 90 | 0 | 0 | 0 | 0 | 10 | 100 |
| Cross Area Proficiency | 0 | 0 | 0 | 0 | 0 | 0 | 0 |