Akashi College	Year	2023	Course Title	Strength of Materials II

Course Information

Course Code	5433	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Mechanical Engineering	Student Grade	4th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	Strength of Materials I, Tomohiro MORISHITA, Masahiko HIRAO, Morikita Publishing Co.		
Instructor	MORISHITA Tomohiro		

Course Objectives

1) Understand the buckling phenomena of long columns, and can design safe columns.
2) Can calculate the stress value and the resulting deformation amount when one-dimensional stress is acting on an non-static member of a mechanical structure.
3) Can use the principle of superposition to calculate the stress and deformation of static and non-static parts of mechanical structures.
4) Understand the multi-axial stress state and its strength evaluation method, and can design the strength of the two-dimensional stress state.
5) Understand the method of calculating the elastic strain energy stored in the workpiece and the theorem associated with it, and can apply it to the calculation of the stress and deformation of the workpiece.
6) Can discuss material dynamics issues with others based on logical thinking.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
(1) Buckling of long columns	Understand the buckling phenomena of long columns, can calculate the buckling loads from the differential equations of the deflection curve correctly, and can design safe columns.	Understand the buckling phenomena of the long column and can design a safe column using Euler's formula and column experimental formula.	Do not understand the buckling phenomena of long columns correctly, and cannot design a safe column using Euler's formula and column experimental formula.
(2) Statically indeterminate problem	Can estimate the deformation state correctly when one-dimensional stress is acting on an non-static member of a mechanical structure, and can calculate the stress value and the resulting deformation amount.	Understand the solution pattern in which one-dimensional stress acts on non-static member of a mechanical structure, and can calculate the stress value and the resulting deformation value using the solution pattern.	Cannot determine the static or non-static nature of mechanical structures. Cannot calculate the stress value and the resulting deformation correctly when one-dimensional stress is acting on a non-static member.
(3) Principle of superposition	Can explain that the principle of superposition is formed in the stress and deformation of static and non-static parts of mechanical structures, and can calculate stresses and deformations applying that.	Can use the principle of superimposition can to calculate the stress and deformation of static and non-static parts of mechanical structures.	Cannot use the principle of superimposition correctly to calculate the stress and deformation of static and non-static parts of mechanical structures.
(4) Multi-axial stress	Understand the state of multi-axis stress , and can explain how it is evaluated for strength. Can calculate stresses for structural members in two-dimensional stress states, and can design intensity based on them.	Understand the multi-axial stress state and its strength evaluation method, and can design the strength of the two-dimensional stress state.	Cannot image the multi-axial stress state correctly, and cannot use its strength evaluation method.
(5) Strain energy	Can explain strain energy during elastic deformation, plastic deformation, and shock loads when static loads are acting. Understand the theorem of elastic strain energy, and can apply the theorem to calculate the stress and deformation of the workpiece.	Understand the method of calculating the elastic strain energy stored in the workpiece and the theorem associated with it, and can apply it to the calculation of the stress and deformation of the workpiece.	Cannot calculate the elastic strain energy stored in the workpiece. Also, cannot apply the theorem correctly to the calculation of stress and deformation of the workpiece.
(6) Logical thinking and interactive communication	Can discuss material dynamics issues with others based on logical thinking and summarize opinions of the group.	Can discuss material dynamics issues with others based on logical thinking.	Cannot discuss material dynamics issues with others based on logical thinking.

Assigned Department Objectives

Teaching Method

Outline	The aim is to be able to calculate the strength of structural and mechanical components and to evaluate the strength of these components, as well as to be able to independently and continuously learn related matters, and to conduct logical thinking and technical discussions. Based on the material mechanics I in the third year, students learn more advanced issues and prepare for the fifth year of material dynamics III, the first year of the major for material dynamics specials, and the second year of the major for fracture mechanics.
Style	Pre-study the textbook and example problems before classes. After the instructor explains the key points of the study material at the beginning of the class, students will have a group discussion. They are also expected to raise questions and unclear points to the instructor for explanation. Work in groups on the exercise assignments prepared by the instructor.
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 study time required for pre-study / review, and completing assignment reports. Try to think and understand yourself. Actively participate in group discussions and contribute to the group's learning activities during class hours. 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	Buckling of long columns	Understand the buckling phenomena of long columns, and can design safe columns.
		2nd	Non-static problem (1) Bars and combination bars constrained by rigid walls	Understand how to solve non-static problems, and can calculate stresses and deformations for basic problems.
		3rd	Non-static problem (2) Non-static static truss, thermal stress, and non-static beam	Can explain how to solve non-static problems with truss, thermal stress, and non-static beam, and can calculate stress and deformation in these problems.
		4th	Principle of superposition (1) The problem is divided, simplified, and static beams.	Can properly break down and separate complex problems. Can apply the principle of superposition to the calculation of stress and deflection for static beams.
		5th	Principle of superposition (2) Non-static beam, and continuous beam	Can apply the principle of superposition to an incapacitated beam. Can use the three-moment theorem for continuous beams.
		6th	Principle of superposition (3) Superposition of the axial force and the idol in the bend	Can calculate the stress of the rod acting on the axial force and the internal bending force using the superposition principle.
		7th	Principle of superposition (4) Asymmetric bending, and tight coil spring	Can explain the unique phenomena of asymmetric bending of beams, and can calculate the stresses using the principle of superposition. Can explain the stress state of a tight coil spring, and can calculate the stresses using the superposition principle.
		8th	Multi-axis stress (1) A plate with normal stress acting in two directions, and a multi-axis stress state	Can explain the state of multi-axis stress and the notation of stress and strain in that case. Can calculate stresses for a simple example of biaxial stress.
	4th Quarter	9th	Multi-axial stress (2) Stress-strain equation	Understand the stress-strain relationship in a multi-axial stress state and, can calculate stresses and strains using it.
		10th	Multi-axial stress (3) Principal stress and principal axes, failure and failure conditions, principal stress and maximum shear stress	Can calculate the stresses, principal stresses, and principal shear stresses acting on any slope at plane stress. Understand the strength evaluation method in a multi-axial stress state, and can design the intensities in a plane stress state.
		11th	Multi-axial stress (4) Mohr's stress circle and a combination of bending and torsion	Can explain how to use the Mohr's stress circle in a plane stress state, and can draw the stress circle of a mall for any plane stress. Can explain the meaning of equivalent bending and torsional moments in the combination of bending and torsional loads, and can calculate principal and maximum shear stresses.
		12th	Strain energy (1) Strain energy, and the law of conservation of energy	Can calculate strain energy when the workpiece is subjected to axial, shear, torsional, and bending loads respectively. Can apply the law of conservation of energy to the calculation of deformation.
		13th	Strain energy (2) Impact load	Understand the strain energy stored in the workpiece in the event of impact loads can be understood, and can apply the law of conservation of energy to impact load problems.
		14th	Strain energy (3) Castigliano's theorem	Understand the Castigliano's theorem, and can apply it to static problems of axial, torsional, and bending loads.
		15th	Strain energy (4) Least work theorem	Understand the least work theorem, and can apply it to non-static problems of axial, torsional, and bending loads.
		16th	Final exam	

Evaluation Method and Weight (%)

	Examination	Exercises	Group work	Total
Subtotal	80	10	10	100
Basic Proficiency	0	0	0	0
Specialized Proficiency	80	5	5	90
Cross Area Proficiency	0	5	5	10