Akashi College	Year	2022	Course Title	Advanced Strength of Materials

Course Information

Course Code	4020	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	MORISHITA Tomohiro		

Course Objectives

1) Systematically understand the methods for solving stress, strain, and displacement in a multiaxial stress state and can apply them to basic problems.
2) Understand the basic issues related to flat plate bending problems, and can compare and examine one-dimensional and two-dimensional problems.
3) Understand the advanced issues related to stress, strain, and elastic moduli, and can use them to three-dimensionally examine various problems of strength of materials.
4) Understand the mechanical behaviors related to the elastoplasticity of materials and how to analyze them, and can apply them to intensity calculations.
5) Can explain the above matters to others.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Systematically understand the basic formula for multiaxial stress and can apply it to basic problems.	Can apply various formulae for multiaxial stress to basic problems.	Cannot apply various formulae for multiaxial stress to basic problems.
Achievement 2	Understand the basics issues related to flat plate bending problems and can explain the difference between beams.	Can calculate stress and deflection of basic problems by using formula related to flat plate bending problems.	Cannot calculate stress and deflection of basic problems related to flat plate bending.
Achievement 3	Understand the advanced issues related to stress, strain, and elastic moduli, and use them to three-dimensionally examine various problems of strength of materials.	Understand the advanced issues related to stress, strain, and elastic moduli.	Do not understand the advanced issues related to stress, strain, and elastic moduli and remain limited to only a one-dimensional understanding.
	Understand the mechanical behaviors related to the elastoplasticity of materials and how to analyze them, and can apply them to intensity calculations.	Understand the mechanical behaviors related to the elastoplasticity of materials and how to analyze them.	Do not understand the mechanical phenomena related to elastoplasticity of materials.
	Can discuss various problems of strength of materials with others based on logical thinking.	Can explain basic concepts and formulae to others on various problems of strength of materials.	Cannot explain to others the formation of various formulae and examples of their use on various problems of strength of materials.

Assigned Department Objectives

Teaching Method

Outline	The aim is to be able to calculate and evaluate the strength of structural and mechanical components, independently and continuously learn related matters, think logically, and have technical discussions. Based on the year 3's Strength of Materials I, year 4's Strength of Materials II, and year 5's Strength of Materials III, students will learn more advanced issues and prepare for Fracture Mechanics in the second year of graduate study.
Style	Classes will be taught in a lecture style with exercises in the second half of class.
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. Students should try to think and understand for themselves. 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	Review of multiaxial stress (1)	Can show a simple application example of stress-strain and displacement-strain relations in the multiaxial stress state.
		2nd	Review of multiaxial stress (2)	Can use equilibrium equations in a rectangular coordinate system. Can derive Navier–Stokes equations. Can use the basic formula in cylindrical and spherical coordinate systems. Can transform various formulae from a rectangular coordinate system to polar coordinate.
		3rd	Flat plate bending (1): Beams and flat plates	Can drive the formulas for beam. Can explain the similarities and extensibility of beams and flat plates.

		4th	Flat plate bending (2): Basic formula for rectangular plates	Understand the handling of unknown functions in bending rectangular plates and can explain the relationship with the basic formula.
		5th	Flat plate bending (3): Stress and deflection of rectangular plates	Can apply the basic formula for rectangular plates to basic problems, and calculate stress and deflection.
		6th	Flat plate bending (4): Axisymmetric bending of circular plates	Can apply the basic formula for a circular plate that is expressed in polar coordinates to a basic problem, and calculate stress and deflection.
		7th	Review of plane stress and plane strain	Can explain the coordinate transformation formulae for stresses in the plane stress states and principal and maximum shear stresses. Can also explain the coordinate transformation formulae for strains in plane strain states and principal and maximum shear strains.
		8th	Stress and strain (1): Direction cosines and coordinate transformations	Can use direction cosines to describe stress coordinate transformations.
	4th Quarter	9th	Stress and strain (2): Stress	Can explain the calculation of principal and maximum shear stresses in a three-dimensional stress state. Can explain stress invariants.
		10th	Stress and strain (3): Strain, strain energy at multiaxial stress, and yield criterion	Can explain the coordinate transformation formula for strain in three-dimensional deformation. Can calculate strain energy in a three-dimensional stress state, and apply it to intensity design.
		11th	Stress and strain (4): Stress-strain equation	Understand generalized stress-strain relations and can explain the elastic modulus for anisotropic elastic bodies.
		12th	Stress and strain (5): Index notation	Can express the formulas using index notation.
		13th	Elastoplastic problems (1): Material models and torsion and bending of elastic-perfectly plastic bodies	Can explain the relationship between load and deformation in the torsion and bending of elastic-perfectly plastic bodies.
		14th	Elastoplastic problems (2): Limit loads and residual stress caused by plastic deformation	Can explain the limit loads in combination rods, the limit loads in beams, and plastic joints. Can explain residual stress caused by plastic deformation.
		15th	Elastoplastic problems (3): Spherical symmetry and axisymmetric problems	Can explain the yield start condition and residual stress of elastic-perfectly plastic spherical shells, cylinders, and rotating circular plates.
		16th	Final exam	

Evaluation Method and Weight (%)

	Examination	Exercise	Total
Subtotal	80	20	100
Basic Proficiency	0	0	0
Specialized Proficiency	80	15	95
Cross Area Proficiency	0	5	5