Tsuyama College	Year	2021	Course Title	Computational Mechanics

Course Information

Course Code	0034	Course Category	Specialized / Elective
Class Format	Lecture	Credits	Academic Credit: 2
Department	Advanced Mechanical and Control System Engineering Course	Student Grade	Adv. 2nd
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials			
Instructor	KOBAYASHI Toshiro		

Course Objectives

Learning purposes :
As an applied course of computer use, learn the main numerical analysis methods applied to specific science and engineering problems, and deepen understanding of computer applied mechanics analysis.

Course Objectives :
1. Approximate formulas can be created using Taylor expansion.
2. The differential equations of the first and second orders can be differentiated.
3. Single-element and multi-element shape functions and stiffness matrix can be derived.
4. Understand the matrix solution method and be able to derive the equations for displacement and stress of multiple elements.
5. Understand the finite element method.
6. Using the general-purpose finite element method code, standard problems of 3D structure, heat transfer, and fluid can be analyzed without much deviation.

Rubric

	Excellent	Good	Acceptable	Not acceptable
Achievement 1	・ The differential equations of the 1st and 2nd floors can be differentiated. ・Can program a simple difference formula to find a numerical solution.	・Approximate formulas can be created using Taylor expansion. ・ The differential equations of the 1st and 2nd orders can be differentiated.	・A basic approximation can be created using Taylor expansion. ・Basic differentiation of first- and second-order differential equations is possible.	・ Understand the basics of the finite element method. ・Using the general-purpose finite element method code, basic problems of 3D structure, heat transfer, and fluid can be analyzed without much deviation.
Achievement 2	・Using the matrix solution method, it is possible to analyze the displacement and stress of specific structural problems of multiple elements.	・It is possible to derive single-element and multi-element shape functions and stiffness matrices. ・ Understand the matrix solution method and be able to derive the equations for displacement and stress of multiple elements.	・It is possible to derive single-element and multi-element shape functions and stiffness matrices. ・ Understand the basic matrix solution method and be able to derive the displacement and stress equations of multiple elements.	・Single-element and multi-element shape functions and stiffness matrix cannot be derived. ・The exercise to calculate the displacement and stress using the matrix solution method cannot be completed by the deadline.
Achievement 3	・Using the general-purpose finite element method code, basic problems of 3D structure, heat transfer, and fluid can be analyzed without much deviation. ・In various analyzes using the finite element method, it can be considered in comparison with the theoretical solution so as not to deviate significantly.	・Understand the finite element method. ・Using the general-purpose finite element method code, standard problems of 3D structure, heat transfer, and fluid can be analyzed without much deviation.	・ Understand the basics of the finite element method. ・Using the general-purpose finite element method code, basic problems of 3D structure, heat transfer, and fluid can be analyzed without much deviation.	・Not understand the finite element method. ・Using the general-purpose finite element method code, it is not possible to analyze basic problems of 3D structure, heat transfer, and fluid without major deviation. ・ Exercises cannot be completed by the deadline.

Assigned Department Objectives

Teaching Method

Outline	* Relationship with business: In this subject, faculty member who has practical experience in digital engineering in research and development work at heavy industry manufacturers will use his experience to teach basic and practical dynamic simulations such as numerical analysis, finite difference method, and finite element method. General or Specialized : Specialized Field of learning : Design and production / management Foundational academic disciplines : Engineering / Mechanical Engineering Relationship with Educational Objectives in advanced course : This subject corresponds to "(2) Acquire knowledge of specialized fields such as materials and structure, motion and vibration, energy and flow, information and measurement / control, design and production / management, machines and systems, and design / policy of machines and systems. Acquire the ability to utilize for operation ", which is one of the learning goals of the advanced course. Relationship with JABEE programs : The main goals of this subject are "(A) Deepening of basic knowledge about technology, A-2" Materials and structure "," Movement and vibration "," Energy and flow "," Information and measurement / control ". , "Design and production," "machines and systems," and "being able to acquire and explain knowledge in specialized technical fields," and also involved in "A-1." Course outline : With the development of electronic computers, the precision and speed of technical calculations have progressed, and numerical experiments have become an important field of engineering methods. We will explain and practice methods for expressing natural phenomena as mathematical models and analyzing them with a computer.
Style	Course method : The lessons will be centered on board writing. Presenting a concrete mechanical model will be tried. Reports will be imposed to deepen student's understanding of the basic principles of computational mechanics. Grade evaluation method : Evaluate by regular examination (70%) and report (30%). Retest in some cases. The retest will be evaluated in the same way as the main test.
Notice	Precautions on the enrollment : This is a class that requires study outside of class hours. A total of 45 hours of study is required per credit, including both class time and study outside class time. Follow the instructions of the instructor regarding study outside of class hours. Course advice : It is desirable to fully understand what you have learned in information processing I, II and numerical analysis. As a preparatory study to be performed in advance, it is necessary to be able to use 3D-CAD in order to create a 3D model in the CAE exercise. Foundational subjects : Applied mechanical design (5th year), design engineering (5th), applied design engineering (2nd in advanced course), information science (1st in advanced course), etc. Related subjects : Design Engineering (5th year), CAD / CAM (5th), Applied Design Engineering (1st in advanced course), Attendance advice : High-performance, inexpensive, and easy-to-use PCs and operating systems have become widespread, and various general-purpose computational mechanics software can be easily used, and the user base of computational mechanics is rapidly expanding. It is important to be able to correctly set analysis problems for basic computational mechanics problems, understand the contents of CAE analysis, and verify the reliability of analysis results by yourself. Students would be recommended to acquire the theory and skills with the aim of becoming a computational mechanic engineer certification test of the Japan Society of Mechanical Engineers. If you are not seated at the beginning of the class, you will be late.

Characteristics of Class / Division in Learning

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

Elective subjects

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	● Guidance	Explain what computational mechanics is.
		2nd	● The basics of mathematics for computational mechanics	Understand mathematics for computational mechanics.
		3rd	Basics of heat conduction and solid-state mechanics Report assignment (1) 3D-CAD	Understanding the basics of heat conduction and solid-state mechanics, a difference equation is required.
		4th	● Basics of the finite element method I	Explain the principle of the finite element method.
		5th	● Basics of the finite element method II	Basic analysis using the finite element method is possible.
		6th	● CAE Exercise (1) Stress Strain Analysis Report assignment (2) Numerical calculation method (1)	It can be confirmed that the basic analysis using the finite element method is valid.
		7th	● CAE Exercise (2) Heat Transfer Analysis	Basic heat transfer analysis using the finite element method is possible.
		8th	● Element selection	Understand the elements of the finite element method and explain their effects.
	2nd Quarter	9th	● Basics of modeling Report assignment (3) Numerical calculation method (2)	Understand the modeling method of the finite element method and explain its influence.

		10th	● Basics of how to use boundary conditions	Understand and apply the types of boundary conditions of the finite element method.
		11th	● Basics of pre-post processing	Understand and apply the prepost processing method of the finite element method.
		12th	● CAE exercise (3) Vibration analysis Report assignment (4) CAE exercise (1)	Basic vibration analysis using the finite element method is possible.
		13th	● CAE Exercise (4) Fluid Analysis	Can perform basic fluid analysis using the finite element method.
		14th	● Basics of result verification, ethics of computational mechanics engineers Report assignment (5) CAE exercise (2)	Understand the ethics of computational mechanics engineers.
		15th	(Final exam)	Attend and submit your answer.
		16th	● Returning answers for final exams and commentary on answers	Correct the wrong answer.

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	70	0	0	0	30	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	70	0	0	0	30	0	100
Cross Area Proficiency	0	0	0	0	0	0	0