2016　Continuum Mechanics

Academic unit or major

Undergraduate major in Materials Science and Engineering

Instructor(s)

Yasuda Kouichi

Course component(s)

Lecture

Day/Period(Room No.)

Tue7-8 Fri7-8

Course number

MAT.C308

Credits

2

Academic year

2016-

Offered quarter

2Q

Language used

Japanese

Note

1. Participant in this course should download each teaching material from OCW-I site (not OCW site).　The teaching material in OCW is a kind of example (not complete version).
2. Participant in this course should download the latest version of the teaching materials. Older version sometimes contains typographical errors etc.

3. For the first three times of classes, the teaching materials (but not latest version) can be downloaded from the WEB site below. If the student does not decide to register, please use it

http://www.cmc.ceram.titech.ac.jp/openlab.html

Course description and aims

This course gives an overview of mechanics, from Newtonian, Lagrangian, Hamiltonian formulation, and via Mechanics of Materials, to Continuum Mechanics. Students should acquire accomplishments to intuitively grasp force balance of multi-body systems and internal stress and strain states in materials although they are usually not visible. By solving each assignment one by one, the students can understand the general principles in mechanics, which is the fundamentals for modern scientists and engineers, and also brings the students touch of learning in their life.

Student learning outcomes

By the end of this course, students will be able to
1) intuitively grasp force balance of multi-body systems
2) intuitively understand internal stress and strain states in materials
3) propose mechanical model to express phenomena in our real world
4) treat mathematical formulation in vector and tensor

Keywords

Newtonian Mechanics, D'Alembert Principle, Free Body Diagram, Lagrangian, Hamiltonian, Stress Vector, Mohr's Circle, Tension, Compression, Shear, Beam, Stress Tensor, Strain Tensor, Displacement, Constitutive Equation, 2-dimensional Elastic Theory

Class flow

The students are required to download teaching materials in every class and read it before coming to class.
The instructor explains the essential points of each class and gives assignment to the students.
The students should solve the assignments during the class.
The instructor designates one of the students who should explain the solution by using chalk and blackboard.
The instructor comments on it, or makes a correction when the solution is not perfect.

Course schedule/Required learning

	Course schedule	Required learning
Class 1	Review on Newtonian Mechanics, Equation of Motion, Principle of Virtual Work	Explain Principle of Virtual Work
Class 2	Review on Newtonian Mechanics, D'Alembert Princple,	Derive Lagrange Equation by using D'Alembert's Princple,
Class 3	Analytical Mechanics, Lagrangue Equation, Application to Coupled System between Mechanical and Electrical Systems	Explain how to make Lagrangian and to solve Lagrange Equation
Class 4	Analytical Mechanics, Hamilton Equation, Hamiltonian in Quantum Mechanics	Derive Hamilton Equation
Class 5	Mechanics of Materials, Stress Vector, Review on Vector, Free body Diagram	Define Stress Vector
Class 6	Mechanics of Materials, Stress tensor, Introduction to Tensor, Mohr's Circle	Derive Stress Tensor
Class 7	Mechanics of Materials, Strain, Hooke's Law, Young's modulus, Modulus of Rigidity, Poisson's Ratio, Bulk Modulus	Define Strain Tensor and 4 Elastic Modulus
Class 8	Mechanics of Materials, Tension and compression of rod, Thermal Stress	Soleve Problems on Tension and Compression in Rod and Thermal Sress
Class 9	Mechanics of Materials, Torsion, Bending of Beam, Shear Force Diagram, Bending Moment Diagram	Solve Problems on Torsion and Bending Beam
Class 10	Mechanics of Materials, Displacement of Beam	Solve Problem on Displacemnet of Bending Beam
Class 11	Continuum Mechanics, Stress Tensor, Equlibrium Equation	Define Stress Tensor in general
Class 12	Continuum Mechanics, Strain Tensor, Compatibility Equation	Define Strain Tensor in general
Class 13	Continuum Mechanics, Constitutive Equation, Generalized Hooke's Law	Expalin Generalized Hooke's Law
Class 14	Continuum Mechanics, Fundamentals of	Define Stress Functiona

	2-dimensional Elastic Theory, Stress Function	
Class 15	Continuum Mechanics, Application of 2-dimensional Elastic Thoery	Show some exaples of 2 Dimentional Elastic theory

Textbook(s)

Teaching materials are distributed in OCW-i

Reference books, course materials, etc.

Landau and Lifshits: Mechanics in theoretical physics series, S.P.Timoshenko, and J.N.Goodier, Theory of Elasticity,

Assessment criteria and methods

Students will be assessed on their understanding of Lagrange Equation, Free Body Diagram, Stress Tensor, Strain Tensor, and their ability to apply them to solve problems.
Students' course scores are based on mid-term(50%) and final exams (50%)

Related courses

LAS.P101 ： Fundamentals of Mechanics 1
LAS.P102 ： Fundamentals of Mechanics 2
MAT.A202 ： Fundamentals of Mechanics of Materials F

Prerequisites (i.e., required knowledge, skills, courses, etc.)

Taking the related classes is recommended, not mandatory.

Contact information (e-mail and phone)

kyasuda@ceram.titech.ac.jp

Office hours

Contact by e-mail in advance to schedule an appointment

Other

The classes are served for students to use their brains and polish their intelligence.