Strength and Fracture of Materials

Syllabus Number 2D302
Basic Major Subjects
Elective Requisites 2 credit

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1. Course Description

Since the invention of the airplane, research into the strength and fracture of materials has made indispensable contributions to establishing safety and reliability. The subjects of this course includes the fundamental knowledge of the strengthening and fracture mechanisms of materials, which engineers must have. Lattice defects and dislocations, the stress strain relation, the strengthening mechanism of metals, creep at high temperature, fracture mechanics and fatigue phenomenon will be presented systematically, based on the elasticity theory.

2. Course Objectives

This course presents the strength and fracture of materials in conjunction with the lattice defects. Properties of materials applying to airplanes and space vehicles will be discussed from the viewpoint of strengthening metallic materials. Student can discuss with experts in the field of strength and fracture of materials. The course includes the following topics,
1. Fundamental elasticity theory
2. Lattice defects and dislocation
3. Stress- strain relation
4. Strengthening mechanism of materials
5. Creep
6. Fracture mechanics
7. Fatigue

3. Grading Policy

Final examination (80%),report (20%)

4. Textbook and Reference

Textbook
M.Kato, S.Kumai and S.Onaka Zairyokyoudogaku (Strength of materials)
Asakura Pub.Co. ISBN-13 978-425436934

5. Requirements(Assignments)

Student must pre-study scientific terms. Lecture note and related papers will be shown up in LMS. Since understanding of lattice defects is not easy, related topics will be presented by DVD animation. Homework will be shown in LMS.

6. Note

Solid mechanics 1 was taken. DVD 'Introduction to Engineering Materials' by C.J.McMahon will be utilized to understand dislocation.

7. Schedule

[1] Elasticity theory 1: Definition of stress, strain and shear stress, shear strain

[2] Elasticity theory 2: Hooke's law for isotropic elastic body

[3] Lattice defects and dislocation 1: Categorize lattice defects and dislocation

[4] Lattice defects and dislocation 2: Edge and screw dislocations in crystal

[5] Lattice defects and dislocation 3: Stress field of screw dislocation

[6] Stress-strain relationship 1: Stress-strain curve

[7] Stress-strain relationship 2: Criterion of necking

[8] Strengthening mechanism 1: Solid solution strengthening and precipitation strengthening

[9] Strengthening mechanism 2: Dispersion strengthening and grain refining

[10] Creep and deformation at high temperature 1: What is creep deformation?

[11] Creep and deformation at high temperature 2: Macroscopic deformation, effects of temperatures and strain rates

[12] Fracture mechanics 1: Griffith's criterion of brittle fracture

[13] Fracture mechanics 2: Plane strain condition and fracture toughness

[14] Fatigue and cyclic deformation 1: Fatigue crack propagation and Paris rule

[15] Final examination and summaries