Strength and Fracture of Materials

ISOGAI, Takeshi

1. Course Description

In this course, the following topics are studied;
(1) Basic concept of the strength and fracture of materials
(2) Understanding of the different types of fracture such as yielding, brittle fracture, fatigue, creep, corrosion, and the interaction among them
(3) Unified concept on fracture, which pays attention to metals, ceramics, polymers and composite materials
(4) Basis of linear fracture mechanics

2. Course Objectives

The objective of the course is to provide students with a basic understanding of strengthand fracture of materials.

3. Grading Policy

Your overall grade in the class will be decided based on followings:
-    Term-end examinination (60%)
-    Mini tests in the class (25%)
-    "Self-made resume" submitted in the 15th lesson (15%)
Feedback will be given by commentary of the mini tests during class.

4. Textbook and Reference

Textbook
Akihiro Tsuchida, Akira Ueno   Strength and Fracture of Materials
         Corona Company (2011) ISBN 978-4-339-04476-8
Reference
M. F. Ashby, translated by Yoshinori Horiuchi,   Introduction to engineering materials   Uchida Roukanho Publication (1999)   ISBN 4-7536-5093-6
Edited by The Japan Society for Materials Science   Strength and Fracture of Materials   Japan Society for Materials Science (2005)   ISBN 4-901381-26-1
Takeo Yokohori   Strength and Fracture of Materials (2nd Edition)   Iwanami Shoten (1974) *   * Please use it in the library etc. due to out of print

5. Requirements(Assignments)

Please review the foundation of materials science studied in "Engineering Material 1" and foundation of mechanics of materials studied in "Strength of Materials 1" before attending class.
Please read the relevant part of the textbook before each lesson. (1.5 hours)
Please review the important items you learned in class by using texts and notes. Please answer the exercises again. (1.5 hours)
As preparatory learning on the 15th lesson, the main points (regime) of the contents learned in the 1st to the 14th lesson are summarized into a designated paper of A4 size. This "Self-made resume" can be used in term-end examination.
Preparation other than above will be instructed in class.

6. Note

The diagrams/tables will be presented by using a projector and explanations will be added on the blackboard. It is important to acquire the habit of noting important matters by the students. Handwritten notes can be brought with the "handwritten regime" at term-end exam.

7. Schedule

[1]	Introduction to "Strength and Fracture of Materials": What is Strength and Fracture of Materials? Ideal strength, Diversity and similarity of fracture
[2]	Strength of materials under statig loading 1: Tensile test, Yielding, Work hardening
[3]	Strength of materials under statig loading 2: Plastic deformation, Dislocation, Slip deformation
[4]	Strength of materials under statig loading 3: Material strengthening method, Ductile fracture, Brittle fracture
[5]	Foundations of elastic mechanics: Equilibrium equation of stress, Relationship between strain and displacement, Generalized Hook's law
[6]	Introduction to fracture mechanics 1: Stress intensity factor, Stress field near the crack tip
[7]	Introduction to fracture mechanics 2: Plasticity ahead of the crack tip, Correction of Irwin, Correction of Dagdale
[8]	Introduction to fracture mechanics 3: Energy release rate, Fracture toughness test
[9]	Fatigue 1: Historical fatigue accident, High cycle fatigue and Low cycle, SN curve
[10]	Fatigue 2: Fatigue crack growth, Threshould stress intensity factor
[11]	Strength of materials at high temperature 1: Creep deformation, Creep damage, Mechanism of creep
[12]	Strength of materials at high temperature 2: Life estimation method, High temperature fatigue, Creep fatigue interactions
[13]	Environmental strength: Oxidation, Stress corrosion cracking, Corrosion fatigue

[14]   Application of statistics to the strength of materials: Foundation of statistics, Reliability, Statistical properties on strength of materials, Normal distribution, Weibull distribution, Application of statistics to strength of materials

[15]   Overall summary and Term-end examination