재료의 기계적 거동
(Mechanical Behavior of Materials)

Introduction

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Class overview

- Understanding 1) fundamental microstructure and mechanical properties relationship, 2) basic theory and ideas on mechanics of materials
- Measurement of mechanical behavior (and properties) and their applications
- Effect of microstructure of materials on elasticity, viscoelasticity, plasticity, creep, fracture and damage
- Strengthening mechanisms of materials

Who will be benefited from the class ?

- Students who are interested in Materials, metallurgy, Mechanical, Naval, Architecture, Aerospace, Applied mechanics etc…
- Have backgrounds on Engineering materials, strength of materials (or mechanics of materials), solid mechanics, microstructure of materials etc.
- Students who want to seek studies on metallurgy, mechanical design, and stress analysis, fracture and damage, numerical method…

Text & References

Text

- **(Main)** Class note
- G. E. Dieter, *Mechanical Metallurgy*, McGraw Hill, SI Metric Edition.
- Robert M. Caddell, *Deformation and fracture of solids*, Prentice-Hall, 1980.
- H. Courtney, *Mechanical Behavior of Materials*, 2nd Ed., McGraw Hill, 2000.

References

1. M.A. Meyers & K.K. Chawla, *Mechanical Behavior of Materials*, Prentice Hall, 1999.
2. D. Hull and D.J. Bacon, *Introduction to Dislocations*, 4th Ed., Butterworth-Heinemann
3. R.E. Reed-Hill and R. Abbaschian, *Physical Metallurgy Principles*, 3rd Ed., Brooks-Cole/Thomas Learning, Boston, MA, 1992.
4. W.F. Hosford, *Mechanical Behavior of Materials*, Cambridge, 2005.
5. 이동녕, *재료강도학, 문운당, 1996*

Content

1. Force & stress, deformation & strain
2. Elastic Behavior & isotropic elasticity
3. Macroscopic & continuum plasticity
4. Plastic Deformation of ductile metals
5. Viscoelasticity for polymeric materials
6. Basics of dislocation theory & strengthening of materials
7. High-Temperature Deformation
8. Fracture Mechanics
9. Composites
10. Fatigue of Materials

Content

1. Force & stress, deformation & strain
2. Elastic Behavior & isotropic elasticity

- Review of stress, strain and elasticity
- Concept of stress/strain transformation using Mohr's circle
- Mechanical behavior of linear elastic solids is discussed

- Most of contents in chapters 1 and 2 were discussed in the "Mechanics of Materials" course

Content

3. Macroscopic & continuum plasticity
4. Plastic Deformation of ductile metals

■Fundamental of plasticity for metallic materials
■Concept of classical yield function

5. Viscoelasticity for polymeric materials

■Time dependent behavior
■Rate equation to describe the mechanical responses of polymeric (or sometimes metals) materials

Content

6. Basics of dislocation theory & strengthening of materials
7. High-Temperature Deformation

■Overview of dislocation theory to explain the macroscopic mechanical behavior of metallic materials.
■Major strengthening of metallic materials through microstructure observations
■Creep behavior at high temperature

Content

8. Fracture Mechanics
9. Composites
10. Fatigue of Materials

- Concept of brittle fracture and fracture mechanics
- Stress intensity factor, strain energy release rate
- Elementary ideas of composite materials
- Mechanical responses under cyclic loading, fracture by the fatigue

Class

Online via Zoom

- **Student should join the class through ETL**
- **Power Point Slides**
- **The PPT slides (in PDF form) will be uploaded on ETL in advance.**
- **Please don’t hesitate to give questions and have discussion during the class.**

Evaluation

- **Homework 20 pts**

- **Written test**

  (Option 1)

  Mid-term exam 30 pts

  Final term exam 40 pts

  (Option 2)

  Mid-term report 20 pts

  Final term exam 50 pts

- **Class attendance 10 pts (-1 pt per missing class <4; -2 pts per missing class >=4; Fail if 1/3 or more missing classes without prior notice**

- **Evaluation absolute evaluation**