ME 531- Inelastic Design Methods
Class Hours: MW, 1-3 pm Talbot- Room 105
Instructor: Prof. Huseyin Sehitoglu
Website: http://html.mechse.illinois.edu/classes/ (Class notes, handouts and HW will be on this site).
Office Hours: Open, Room 237 CAB (Computer Applications Building)
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Class notes will not follow any particular text.

Recommended Textbooks:

(1) Strengthening Mechanisms in Crystal Plasticity, A.S.Argon, online UIUC http://www.oxfordscholarship.com.proxy2.library.illinois.edu/view/10.1093/acprof:oso/9780198516002.001.0001/acprof-9780198516002
(2) Mechanics of Solid Materials, R. Asaro, V.Lubarda, Online Library UIUC https://www-cambridge-org.proxy2.library.illinois.edu/core/books/mechanics-of-solids-and-materials/BA29D281AB4356A7CAFB2D938FBA0632
(3) Fatigue of Materials, S. Suresh, Cambridge,1991
(4) Physics of Creep, F.Nabarro, CRC Press, 1995
(5) T. Mura, Micromechanics of Defects in Solids, Nijhoff,1982,1991, https://link-springer-com.proxy2.library.illinois.edu/book/10.1007%2F978-94-011-9306-1
(6) WARP 3D Open Source Code-downloadable from http://www.warp3d.net/ . Intro lecture is available under downloads as well as the manual
(7) LAMMPS Open Source Code, http://lammps.sandia.gov for molecular dynamics

We will make references to the above text and others during course coverage.

Outline

1. Fundamentals of Deformation- Micro- to Macro- Transition, rate- temperature-pressure effects, Non-Schmid Effects
2. Overview of Plasticity, Constitutive Modeling
3. Solution of Deformation Fields under Thermo-mechanical Loading (application to tension-torsion, contact loading)
4. Contact Mechanics Plasticity
5. Gurson Plasticity
6. Introduction to Molecular Dynamics, LAMMPS Open Source Code, Visualization of Slip and Deformation
7. Introduction to Micro-mechanics, Dislocation Mechanics, Peierls -Nabarro, Kink pairs
8. Latent Hardening
9. Finite Strain Plasticity, Crystal Plasticity, WARP3D Open Source Code
10. WARP3D-Cyclic Const Models
11. Cohesive Models, Hydrogen Plasticity
12. Irwin Model, Dugdale Model, HRR Fields
7. Fundamentals of Fatigue, and Design Concepts
8. Fundamentals of Fracture and Creep, and Design Concepts

Grade:

25% Homework
20% Midterm
30% Final
25% Project
Late homework will not be accepted.

Classical Textbooks on Plasticity

W. Prager (1959), An Introduction to Plasticity, Addison-Wesley, Reading, Mass.

R. Hill (1950), The Mathematical Theory of Plasticity, Clarendon Press, Oxford

L.M. Kachanov (1974),Fundamentals of the Theory of Plasticity, Mir Publishers,

A. Mendelson (1983), Plasticity: Theory and Application, Robert Krieger, (reprint)

Other Textbooks on Plasticity

J. Chakrabarty (1987) , Theory of Plasticity, McGraw Hill

A. Khan, S. Huang (1995), Continuum Theory of Plasticity

Historical Works on Plastic Deformation

H. Tresca (1864), Sur l'ecoulement des corps solids soumisa de fortes pression, Compt. Rend., 59,754

G.I. Taylor, C.F. Elam (1923) The distortion of an Aluminum Crystal During a Tensile Test, Proc. R. Soc. London, A102, 603-667.

Von Mises, R.(1928) Mechanik der PlastichenFormanderungvon Kristallen, Z. Agnew. Math. Mech, 8, 161-185

A. H. Cottrell (1953) Dislocations and Plastic Flow in Crystals, Oxford University Place, London