University of Wisconsin - Madison
College of Engineering [EGR]
Last Offered: 2015 Spring [1154]
Direct Link to this Syllabus :
http://aefis.engr.wisc.edu/index.cfm/page/CourseAdmin.ViewABET?coursecatalogid=449&pdf=True

1. **M S & E 352, Materials Science-Transformation of Solids**
2. **Credits :** 3 **Contact Hours :** 4.2
3. **Textbook and Materials :**

   Class notes-prepared by instructor.

a. **Other Supplemental Materials :**

   "Phase Transformations in Metals and Alloys", D. A. Porter and K. E. Easterling, Chapman & Hall (Second Edition (1992).

   "Physical Metallurgy Principles", R. E. Reed-Hill, and R. Abbaschian (Third Edition) PWS-Kent (1992).

   "Materials Principles and Practice", C. Newey and G. Weaver, Butterworths (1990).

   "Fundamentals of Physical Metallurgy", J. D. Verhoeven, J. W. Wiley (1972).

   Additional notes, homework problems and solutions are posted on course E-COW2 site.

- **Specific Course Information :**

a. **Brief description of the content of the course (Course Catalog Description) :** The basic factors that determine phase equilibria, structural and transformation characteristics of solids. Principles governing the thermodynamics and kinetics of phase transformations and microstructure evolution. Nucleation and growth processes in precipitation, recrystallization, solidification, oxidation, martensitic, ordering and spinodal reactions. Transformation behavior in polymers, biomaterials and nanomaterials.
b. **Pre-requisites or Co-requisites :** MS&E 350, or 351 or consent of instructor
c. **This is a Required course.**

- **Specific Goals for the Course :**

a. **Course Outcomes :**
b. **ABET Student Learning Outcomes :**

   (a) Ability to apply mathematics, science and engineering principles.
   (b) Ability to design and conduct experiments, analyze and interpret data.
   (c) Ability to design a system, component, or process to meet desired needs.
   (e) Ability to identify, formulate and solve engineering problems.
   (f) Understanding of professional and ethical responsibility.
   (h) The broad education necessary to understand the impact of engineering solutions in a global and societal context.

(i) Recognition of the need for and an ability to engage in life-long learning.
(k) Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

- **Brief List of Topics to be Covered :**

  Fluency in the kinetics and thermodynamics of phase reactions used for understanding microstructural evolution during phase transformations..

  Fluency and breadth in foundational tools of materials science and engineering as a basis for subsequent courses.

  Dislocation energetic and dynamics

  Diffusion analysis/multiphase alloys

  Driving force and mobility

  Diffusion in glasses and nonmetallic systems

  Interface equilibrium and migration

  Nucleation behavior and kinetics

  Crystal growth/ Alloy solidification

  Recrystallization

  Thermodynamics of phase equilibria

  Spinodal decomposition

  Ordering reactions

  Martensite reactions/ shape memory effect

  Transitions in biomaterials

  Nanomaterial reactions