

1. MME 3407 Mechanical Behavior of Materials
2. 4 Credit Hours, 3 Lecture Hours and 3 Lab Hours
3. S.K. Varma
4. “Mechanical Behavior of Materials”  
M.A. Meyers and Krishan K Chawla  
Cambridge University Press, 2009
5. Specific course information
  - a. The microstructure-property relationship will be emphasized in this course. The deformation and processes for metals, ceramics, p[olymers and composite materials will be analyzed in terms of current theory and models. The topics include twinning, martensite, fracture, dislocation theory, plastic deformation, creep, fatigue, strengthening mechanisms and mechanical testing.
  - b. MME2303, MME3406
  - c. Required
6. Specific goals for the course
  - a. Learning Outcomes
    - Relate the concepts of metallic, ionic, covalent and vander Waal’s bonding and structures to properties in metals, ceramics and polymers (Exam I)
    - Differentiate between the various polymer deformation techniques such as homogeneous flow, shear banding, crazing and glassy polymers (Exam I)
    - Describe the basic features of stress-strain curves using true and nominal values of stresses and strains (Exam I and II)
    - Understand concepts of strain rate effects, plastic deformation in compression testing, Bauschinger effect, plastic deformation in glasses, role of viscosity in amorphous materials (Exam II)
    - Learn hardness testing (Rockwell, Brinell, Vickers and Microhardness testers (Exam II)
    - Identify anisotropy and texture development (Exam II)
    - Indicate the imperfections in materials: Point defects (interstitial solute atoms, self-interstitial atoms, Frankel and Schottky) (Exam II)
    - Calculate the theoretical strength for brittle and ductile materials (Exam II)
    - Explain dislocation behavior and the effect of temperature and strain rate on dislocation movements (Exam II and III)
    - Explain point, line and surface defects (Exam III)
    - Explain grain size strengthening using dislocation pile-up theory (Exam III)
    - Illustrate work hardening and Schmid’s law for calculating the resolved shear stress in slip planes in slip directions (Exam III)
    - Distinguish between various strengthening mechanisms (Exam IV)
    - Examine the creep behavior in metals and polymers (Exam IV)

- Examine the fatigue deformation mechanisms in metals and polymers: fatigue life prediction using S-N curves and constant strain amplitude tests (Exam IV)

b. Student Outcomes:

	<b>Outcome</b>	<b>Level*</b>	<b>Relevant Activities</b>
1.	(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science and mathematics	<b>H</b>	1(a). Basics of mathematics, science and engineering. 1(b) Fundamentals on theoretical and experimental levels can allow the ability to develop such objectives. 1(c) Use of metallography and mechanical testing.
2.	(2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare as well as global, cultural, social environmental, and economic factors.	<b>H</b>	It is addressed by lectures, discussions, small-scope lab assignments, and the team design project.
3.	(3) an ability to communicate effectively with a range of audiences	<b>H</b>	Project presentations and final technical reports.
4.	(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	<b>M</b>	4(a) Introduced mainly through the class discussions and projects. 4(b) Discussion of specific impacts as they arise in projects and in professionalism discussions.
5.	(5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	<b>H</b>	Team design projects.
6.	(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions	<b>H</b>	Projects are basically used to accomplish this outcome.
7.	(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	<b>L</b>	Professionalism discussions

\* **H=high content; M=medium; L=low; 0=no significant content.**

7. Brief list of topics to be covered

Material structure, plasticity, point, line, interfacial, twinning and volumetric imperfections in solids involved in metals, polymers, ceramics and composite materials, geometry of deformation, strengthening mechanisms from solid solutions dispersion, and precipitation hardenable alloys, creep plasticity, fatigue and composite materials.