

**MECH-580 Properties of Polymers
Summer Term 2002
(Required in Specialty)**

2002 Catalog Data: Credit: (4-0-4) Four Lecture-Hours
Prerequisites: Senior II Standing; MECH-200, Introduction to CAE;
MECH-212, Mechanics II; MFGG-370, Engineering Materials

This course begins with thermo-mechanical properties of commodity thermoplastics and includes a review of structure/nomenclature. The course then addresses: polymer shape and size, amorphous and crystalline states, T_g , T_m , rubber elasticity and viscoelasticity (creep). There will be materials' selection and design projects.

Textbooks: *Introduction to Physical Polymer Science* 3rd Ed., L.H. Sperling, 2001

References: 1. *Polymer Engineering and Science*,
2. *Prospector@* (web based plastic materials data base)
3. *IDEAS@ tutorials*

Coordinator: Charles C. Davis

Course learning objectives:

Upon completion of the course the student will be able to:

1. List thermo-mechanical properties of commodity thermoplastics. [ME PO's: A, G, K]
2. Draw structures and give names for selected thermoplastics. [ME PO's: A, G, K, P]
3. Estimate CED, modulus, specific volume and T_g from structure. [ME PO's: A, KP]
4. Correlate free volume with T_g [ME PO's: A, K, P]
5. Estimate crosslink density from the shear modulus. [ME PEO's: A, E, K, M, P]
6. Derive an apparent modulus from creep data. [ME PO's A, E, K, M, P]

Prerequisites by topic:

1. *IDEAS* (or equivalent) skills.
2. Basic PC skills (word processing, spreadsheet and web).
3. Organic nomenclature.
4. Analysis of stress & deformation (solid body mechanics).

Topics covered:

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|--------------------------------------|-------------|
| 1. Thermo-mechanical properties. | [2 |
| Weeks] | |
| 2. Structure-nomenclature | [1 Week] |
| 3. Thermoplastic material selection. | [1 Week] |
| 4. Polymer shape and size. | [1.5 Weeks] |
| 5. Amorphous and crystalline states. | [2 Weeks] |
| 6. Free volume, T_g and T_m | [1 Week] |
| 7. Rubber elasticity. | [1.5 Weeks] |
| 8. Viscoelasticity and creep | [1 Week] |

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Schedule: Two 120-minute lecture sessions per week.

Computer usage: CAD drawings of all geometries. FEA simulations of loading. Plastic material data base searching..

Laboratory projects: N/A

Relationship to professional component: Two- credits of Engineering Science and
Two credits of Engineering Design.

Prepared by: Charles C. Davis

Date: 11/01/02