

IME 2500

PLASTICS PROPERTIES AND PROCESSING

COURSE SYLLABUS – Spring 2012

2011-2012 Catalog Data:

Effects of polymer chemistry, additives, plasticizers, fillers, and reinforcements on the properties of plastics. Molding, forming, extrusion, casting, lamination, coating, welding, and decorating of thermoplastic and thermoset materials. Lecture/Lab: (2/3 hours per week), Credits: 3 hrs. Recommended prerequisite: CHEM 1100.

Prerequisites by topic:

1. Working knowledge of the periodic table, chemical reactions, compound formation, valence and bonding. (CHEM 1100 - General Chemistry I)

Textbooks: Lokensgard, E. (2010). Industrial Plastics - Theory and Application, 5th Edition, Delmar.

Engelmann, P. (2011). Plastics Properties and Processes. (Lecture/lab Manual)

Course Coordinator: Dr. Paul Engelmann, Professor and Chair, Industrial and Manufacturing Engineering. F-232 Parkview, (269) 276-3250, paul.engelmann@wmich.edu

Lab Instructor: Vince Csapos, (616) 298-1481, vincent_d_csapos@whirlpool.com
 Ryan Kamm, ryan.kamm@wmich.edu

| Course Objectives | Performance Criteria (department) ¹ Course | ABET/TAC Outcomes ² |
|---|---|--------------------------------|
| 1. Identify a logical potential polymer for a given plastic product. | (D3) List of series of appropriate polymers for a given well-defined application. | d |
| 2. Perform experiments with major forming, casting and molding processes found in the plastics industry | (C2) Determine the most appropriate process settings for a combination of process variables in a compression molding experiment. | c* |
| 3. Define the dependent and independent processing variables found within plastics processes. | (C1) Correctly differentiate between dependent and independent variables in write-ups of the laboratory experiments. | c |
| 4. Identify the relationship between the chemical make-up of selected plastics and certain of their resulting physical and mechanical properties. | (B3) Determine the molecular weight of a mer given a chemical diagram of a polymer. | b |
| 5. Evaluate polymer materials and product disposal at the end of use. | (J1) Determine appropriate methods disposal processing of waste plastics based upon the makeup of the polymer(s) involved. | j* |
| 6. Correctly identify the plastics process used to manufacture a product from the attributes of the part. | (D4) Determine the process used to produce a plastic part, through deductive reasoning based strictly on product design attributes. | d |

Performance Criteria¹: IME performance criteria may be found at <http://www.wmich.edu/ime>

ABET/TAC Outcomes²: Outcomes may be found at <http://www.abet.org/>

* Results tracked in ABET course notebook

| <i>WEEK OF</i> | <i>LECTURE TOPICS</i> | <i>ASSIGNMENTS</i> | <i>LAB ACTIVITY</i> |
|--------------------|---|--|---|
| January 9 | Course introduction Molecular weights & distributions | Safety Guidelines Chapter 1 & 4 | Lab Safety Discussions of plant tour Discussion of lab write-ups Slush & Dip Casting |
| January 16 | MLK Observation Polymerization reactions Synopsis guidelines | Chapter 3 | Tour setup & display guidelines Compression, Injection (resin 1) Rotational Casting Mini research paper discussion |
| January 23 | Structure & compounds Additives | Synopsis (3%) due Chapter 8 | Discussion of process variables Open lab |
| January 30 | Colorants & fillers Reinforcements | Chapter 6 & 7 | Resin Data report discussion VanDorn demo & lab Open lab |
| February 6 | Test methods Olefins | Mini Research outline & refs. due Appendix E | VanDorn Injection Molding First displays |
| February 13 | Test 1 Commodity polymers | Resin Data report (3%) due Appendix F | Injection (resin 2), Thermoforming Fluidized Bed Second displays |
| February 20 | Engineering thermoplastics | VanDorn report (3%) due Chapter 11 | Injection (resin 3) Third displays |
| February 27 | Thermoset resins Plastication | Chapter 10 Compression lab (4%) due | Fourth displays |
| March 5 | Spring break | | |
| March 12 | Extrusion systems Test 2 | Chapter 13 Slush or dip lab (2%) due | Injection (resin 4) Fifth displays |
| March 19 | Injection molding Blow molding | Chapter 14 & 15 Mini Research paper (5%) due | Injection (resin 5) Sixth displays, Open lab |
| March 26 | Compression & transfer Other thermoset processes | Chapter 17 & 19 | Rotational Presentations (2%) due |
| April 2 | Thermoforming | Thermoforming lab (2%) due Chapter 2 | Seventh/make-up displays Open Lab |
| April 9 | Casting & coating processes Environmental issues | Fluidized bed lab (2%) due | Open Lab |
| April 16 | Final review & synthesis | Injection molding lab (5%) due | Lab clean up |
| April 23 | Comprehensive Final Exam – Monday, April 23 @ 12:30 p.m. – 2:30 p.m. | | |

Evaluation:

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|--------------------------------------|------------|
| 1. Lab experiments | 20% |
| 2. Industrial tour and display | 5% |
| 3. Reports and papers | 11% |
| 4. Homework, quizzes & participation | 7% |
| 5. Test 1 | 15% |
| 6. Test 2 | 15% |
| 7. Final exam | 17% |
| 8. Identification exam | <u>10%</u> |
| | 100% |

The grading scale for this course is as follows:

93-100 = A 89- 92 = BA 83-88 = B
 79-82 = CB 73-78 = C 69-72 = DC
 63-68 = D <62 = E

Usage of Electronic Devices during Class

Cell phones, PDA's and Blackberries are to be turned off or set to vibrate. They are to be placed either at the front of you desk or in a back pack or purse. As there is now conclusive data that taking notes on a standard laptop not only lowers the performance of the student using it, but also of those sitting next to and behind the student, laptops may no longer be used during lectures. However, laptops are encouraged for data collection and report activities in the lab. Surfing the web, sending email, text messaging, talking on a cell phone, listening to an iPod or Mp3 player in class is prohibited.

Laboratory Projects:

Students in this class are required to do bench-scale experiments in the following areas: compression molding, injection molding, rotational casting, dip or slush casting, fluidized bed coating, and thermoforming. Students will gain familiarity with the molding and forming equipment used for these experiments. The primary purpose of this work is to gain an understanding of the relationship between process, product, and material variables.

Oral and Written Communications:

Each student will function as a member of a three-person lab team for the duration of the semester. All lab experiments will be conducted and discussed as a group; **however write-up for each experiment must be done individually**. Group communication and coordination will be evaluated during the presentation each group delivers to explain the inter-relationship of process and product that they observed during their plant tour. Precise, succinct, and thorough writing is required for each of the laboratory experiments, as well as the reports

Expectations for Participation:Excused Absences

Each student is allowed to miss **two** class periods without being penalized. These **two** excused absences are provided as a buffer against bad weather, illness, family problems, job and class conflicts. In the case of illness, WMU does not wish to have any student attend class if they suspect that they have the flu or other serious contagious illness.

These two (2) excused absences in no way relieve you of any class responsibilities. You are responsible for all missed materials such as handouts and should review other class members' notes for lectures and demonstrations missed. Any assignment due on the day of an excused absence is considered due at the beginning of the next class period you attend.

If sickness or other unforeseen circumstances arise to prevent class attendance, please email your instructor immediately to determine how assignments and tests will be handled.

Unexcused Absences

If more than two (2) class periods are missed, a written doctor's excuse is required or the absence will be considered unexcused. The participation grade will be reduced for each unexcused absence.

Late Assignments

Assignment due dates will be posted and assignments must be handed in on those dates. These dates may be changed for the entire class, but dates will not be changed to meet the needs of any individual. Late assignments will be docked a substantial amount of points (at least 10%), if they are accepted at all.

Academic Honesty

Experiments are best done with others as a group. Write-ups will be done as an individual. Failure to observe this directive will result in the penalties outlined in the University policy on academic honesty. You are responsible for making yourself aware of and understanding the policies and procedures in the Undergraduate and Graduate Catalogs that pertain to Academic Honesty. These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse. [The policies can be found at <http://www.wmich.edu/catalog> under Academic Policies, Student Rights and Responsibilities.] If there is reason to believe you have been involved in academic dishonesty, you will be referred to the Office of Student Conduct. You will be given the opportunity to review the charge(s). If you believe you are not responsible, you will have the opportunity for a hearing. You should consult with your instructor if you are uncertain about an issue of academic honesty prior to the submission of an assignment or test.

Clean-up Responsibilities

Between five and ten minutes before the end of each class period, it is the responsibility of each class member to:

1. Place molded items in your locker or book bag
2. Return tools to tool cabinet or to designated location.
3. Return materials being worked on to locker or designated areas.
4. Brush machine or bench top clean of any waste materials.
5. Sweep the floor of the work area.

If each class member will do his/her part, then the laboratory will remain orderly, clean, safe, and a good environment in which to work.

NOTE: The last lab period of this class is designated as a comprehensive laboratory clean up. This time is set aside in each class to return the laboratory to the same (or better) condition than existed on the first day of class. Failure to participate will result in loss of **one full letter grade** in this class. If the student is unable to participate at the scheduled time, arrangements should be made with the Instructor to establish a mutually acceptable make-up time.

Safety

All students are expected to conduct themselves in accordance with both departmental and college safety guidelines while in class. Furthermore, students are required to wear their ANSI safety glasses at all times while in the laboratory.

Students **must** comply with safety disposal procedures for all chemicals that cannot be recycled. Procedures are outlined in the departmental Hazardous Materials Policy. Failure to follow safe procedures will result in a lower grade.

Materials to Be Provided by Students:

- | | |
|---|---|
| 1. A shop coat or other protective clothing | 3. Padlock |
| 2. ANSI approved pair of safety glasses | 4. Materials for group display & presentation |