

**EDMM 5500**  
**ADVANCED PLASTICS PROCESSING**  
**COURSE SYLLABUS**

**2018-2019 Catalog Data:**

Review of optimum machine components and systems. Identification of key process variables within injection molding and extrusion systems. Discussion of the causes of process instability. Determination of the process capability within injection molding and extrusion systems.

**Prerequisites by topic:**

1. Knowledge of the elements of plastication
2. Basic understanding of plastics equipment, tooling and process
3. Understanding of the relationship between resins, additives and the extrusion and injection molding processes
4. Ability to correctly differentiate independent and dependent variables

Note: It is the responsibility of each student to correct any deficiencies that they may have in prerequisite information. This will be assisted by taking the pretest and completing the corresponding reading assignments attached to questions missed on the test. In addition, other readings may be necessary. It is also recommended that students spend time in a plastics processing plant to observe elements of the injection molding process and tooling that are not well understood.

**Texts:** Engelmann, P. & Dealey, R. (2000). Injection mold design guidelines: Maximizing performance using copper alloys – Reprint of a nine part series. Modern Mold and Tooling. New York: Copper Development Association.  
[https://www.copper.org/applications/industrial/modern\\_mold\\_tooling.html](https://www.copper.org/applications/industrial/modern_mold_tooling.html)

**Reference:** Lokensgard, E. (2017). Industrial Plastics - Theory and Application, 6th Edition, Delmar.

**Course Coordinator:**

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**Objectives<sup>1</sup>:**

At the end of the semester the student should be able to:

Course Objectives	Performance Criteria (department) <sup>1</sup> Course	ABET/ETAC Outcomes <sup>2</sup>
1. Understand the relationships between part design, mold design, processing and the product.	(D4) Describe the interrelationships between part & mold design attributes and the resulting product characteristics.	d
2. Consider how process may be the root cause of related material failures.	(F1) Propose likely areas of process related product failure, based upon the material composition of the part.	f
3. Understand the relationship between key intermediate process variables and product consistency.	(K3) Explain how the key intermediate process variables control the quality and consistency of plastics products.	k

4. Identify process system design characteristics most likely to enhance product stability.	(D4) Describe changes to a process system that would enhance product stability.	d
5. Differentiate among, independent process variables, dependent process variables, intermediate dependent process variables, and dependent product variables.	(C1) Categorize specific process variables as independent, dependent process, intermediate dependent process, or dependent product.	c
6. Identify logical variables for a given process problem	(F5) List a group of variables that are both logical and independently testable for a specific process problem.	f

**Performance Criteria<sup>1</sup>:** EDMMS performance criteria may be found at:

<http://www.wmich.edu/EDMMS>

**ABET/ETAC Outcomes<sup>2</sup>:** Outcomes may be found at <http://www.abet.org/>

\* Results tracked in ABET course notebook

### Lecture Topics:

- Week 1**      Introductions and background Pretest  
Discussion of research projects  
Classification of variables
- Week 2**      MLK Observance
- Week 3**      Research projects  
Relationship of water and plastics  
Chemistry & physics  
The drying process  
Performance of the molded product
- Week 4**      Resin additives  
Coloring plastics (visual issues, processing and property changes)  
Fillers & reinforcements  
Defining product failures (visual, dimensional, structural, functional)
- Week 5**      *Research proposal due*  
Research projects – SPE “Write Now”  
Effects of polymer structure and part design on processing  
Review of design rules  
Proof of uniform wall stock rule of thumb  
Comparison of amorphous vs crystalline materials in PVT fundamentals
- Week 6**      “Research beyond Google”
- Week 7**      Test 1  
Critical intermediate "Plastic Variables" - (*Bozzelli - “How to track a perfect part”*)  
Polymer viscosity  
Temperature of the polymer  
Pressure of the polymer  
Cooling rate of the polymer
- Week 8**      *Research bibliography due*  
Impact of mold design on plastic pressure  
Midterm review

- Week 9** Cooling – the big picture (*Engelmann & Dealey “Mold Design Guidelines”*)  
Mold cooling system design  
Towers, chillers & pumps  
Water related issues, filters & treatment
- Week 10** Test 2  
Defining and understanding the molding/processing window  
Selection of variables in plastics processing
- Week 11** Tying it all together: Plastics part and mold design  
Increase the likelihood of a stable molding process  
Reducing product faults, failures and rejections
- Week 12** Simple test methods to identify common plastics
- Week 13** *Research paper due*  
Strategies to setup the process for a given mold
- Week 14** Non-welded assemblies  
Snap-fits & fasteners  
Summary & Final exam review
- Week 15** Final Exam:

**Evaluation:**

1.	Research Topic Proposal	4%	The grading scale for this course is as follows:			
2.	Bibliography	4%				
3.	Research Paper	28%	93-100 = A	83-88 = B	73-78 = C	63-68 = D
4.	Participation	5%	89- 92 = BA	79-82 = CB	69-72 = DC	<62 = E
5.	Test 1	16%				
6.	Test 2	16%				
7.	Final	<u>27%</u>				
		100%				

**Usage of Electronic Devices during Class**

Cell phones are to be turned off or set to vibrate. They are to be placed either at the front of your desk or in a back pack or purse. Surfing the web, sending email, text messaging, talking on a cell phone, listening to music or podcasts in class is prohibited.

**Expectations for Attendance:**

Excused Absences

Each student is allowed to miss 1 week of class without being penalized. This excused absence is provided as a buffer against family problems, weather, 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. Please email your instructor immediately to determine how assignments and tests will be handled.

The excused absence in no way relieve the student of any class responsibilities. The student is responsible for all missed materials 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 attended.

If sickness or other unforeseen circumstances prevent attendance, the student should email his/her instructor at the time of the absence.

#### Unexcused Absences

If more than 1 week of class is missed, a doctor's note or other documentation is required or the absence will be considered unexcused. The attendance grade will be reduced for each unexcused absence.

#### Late Assignments

Late assignments will be docked a substantial amount of if they are accepted at all. An assignment over 1 week late will require Dr. Engelmann to determine if the assignment will be accepted and what additional penalty will be applied.

### **Academic Honesty**

Experiments are best done 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.

“Students are responsible for making themselves aware of and understanding the University policies and procedures that pertain to Academic Honesty. These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse.” The academic policies addressing Student Rights and Responsibilities can be found in the Undergraduate Catalog at <http://catalog.wmich.edu/content.php?catoid=24&navoid=974>

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) and 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. In addition, students are encouraged to access the Code of Honor, as well as resources and general academic policies on such issues as diversity, religious observance:

- Office of Student Conduct [www.wmich.edu/conduct](http://www.wmich.edu/conduct)
- Division of Student Affairs [www.wmich.edu/students/diversity](http://www.wmich.edu/students/diversity)
- Registrar's Office [www.wmich.edu/registrar](http://www.wmich.edu/registrar) and [www.wmich.edu/registrar/policies/interfaith](http://www.wmich.edu/registrar/policies/interfaith)

### **Academic Accommodation:**

Any student registered with Disability Services for Students (DSS) who would like to discuss accommodations for this class should contact the instructor of record in a timely manner. Students with documented disabilities who are not registered with DSS should call the office at (269) 387-2116 or visit [www.wmich.edu/disabilityservices](http://www.wmich.edu/disabilityservices). Students cannot request academic accommodations without scheduling an appointment and meeting with a DSS staff member. If a student does not register with DSS, their academic accommodations/modifications cannot be executed.

### **Research:**

- a. This research is designed to allow the student to participate in a comprehensive information gathering exercise. A group of 2-4 people shall work on each project (including the written portion). The area of study must constitute a part of plastics processing technology and must be approved by the instructor.
- b. The maximum paper length is five (5) pages, including illustrations, in accordance with SPE format.
- c. Four (4) to six (6) illustrations are to comprise the last one (1) to two (2) pages of the paper.
- d. A minimum of six (6) references must be **cited** in the paper.

- e. At least half of the sources for this research paper must come from other sources than the web. Use of the Engineering Index and on-line indices will be necessary to provide the depth and breadth of research materials required for this report. Other sources such as master's theses and doctoral dissertations may be reviewed as part of this work.
- f. A comprehensive appendix containing all relevant supporting data or information to support the work shall be submitted in a 3-ring binder along with the paper.
- g. A written log of project activities for each member of the research team will be graded.

Prepared by: Paul Engelmann

Date: March 2018