IME 5500
ADVANCED PLASTICS PROCESSING
COURSE SYLLABUS – Spring 2008

2007-2008 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 may be done 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 the plant to observe elements of the injection molding process and tooling that are not well understood.

Text: 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.

Reference: Rosato, D. V. and Rosato D. V. (1995). Injection molding handbook (4th Ed.). Norwell, MA: Kluwer Academic.

Colby, P. N. (2006). Plasticating Essentials. Youngstown, OH: Spirex. (www.spirex.com)

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Objectives[1]:

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

1. Understand the function of the major systems within molding. [a & K]

2. Identify process system design characteristics most likely to enhance product stability. [d & C]

3. Differentiate among, independent process variables, dependent process variables, intermediate dependent process variables, and dependent product variables. [c & B]

4. Define the causal relationship between independent, intermediate, and dependent variables for injection molding. [c & B]

5. Identify a logical set of testable variables for a given process problem. [f & E]

6. Understand basic and advanced measurement techniques for a current plastics process. [b & A]

[1] *Lower case letters in the parentheses at the end of each objective refer to the TAC of ABET 2001*

criteria, upper case letters are EAC of ABET 2000.

Evaluation:

1.	Research Topic Proposal	4%
2.	Bibliography	5%
3.	Research Paper	28%
4.	Participation	4%
5.	Midterm	29%
6.	Final	30%
		100%

The grading scale for this course is as follows:

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

Performance Criteria[2]:

The student should be able to:

Objective 1

a. Identify the most critical systems within injection molding, and describe their function. [3, 4]

Objective 2

a. Identify the system components most likely to be the contributing factor for a given type of process instability. [3, 4]
b. Describe changes to a process system that would enhance product stability. [3, 4]

Objective 3

a. Correctly categorize specific process variables as independent, dependent process, intermediate dependent process, or dependent product. [2, 3]

Objective 4

a. Define the four critical intermediate dependent process variables for molding and extrusion systems, and be able to discuss the intermediate nature of each one. [3]
b. Explain the probable relationship between the role of input variables (independent and intermediate dependent) and the resulting output variables (dependent product) for a given process scenario. [2, 3, 4]

Objective 5

a. List a group of variables that are both logical and independently testable for a specific process problem. [1, 2, 4]
b. Determine to what extent a set of potential variables is testable, and what controls would need to be instituted to assure collection of sound data. [1, 2, 4]

Objective 6

a. For a given process parameter, describe logical methods of measuring the variable. [4]

[2]*Numbers in brackets refer to the method of evaluation as listed in the previous section.*

Expectations for Participation:

Usage of Electronic Devices during Class

Cell phones are to be turned off or set to vibrate. PDA's and Blackberries may be accessed for scheduling issues related to class. Laptops may be used for taking notes pertaining to the topic being discussed in the class at the time of use. Surfing the web, sending email, text messaging, talking on a cell phone, listening to an iPod or Mp3 player in class is prohibited**.**

Excused Absences

Each student is allowed to miss one class period without being penalized. This excused absence is provided as a buffer against bad weather, illness, family problems, job and class conflicts.

This excused absence in no way relieves the student of any class responsibilities. The student is 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 attended.

If sickness or other unforeseen circumstances arise to prevent class attendance, the student should contact their instructor via phone or email.

Unexcused Absences

If more than one week of class is missed, a written doctor's excuse or other similar document is required or the absence is considered unexcused.

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 an individual student. 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 (pp. 274-276) Catalog that pertain to Academic Honesty. These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse. 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 me if you are uncertain about an issue of academic honesty prior to the submission of an assignment or test.

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 molding technology and must be approved by the instructor.
b. The paper is to be a maximum of 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 that 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.

Lecture Topics:

January 8
- Introduction
- Research projects
- Classification of variables

January 15
- Research projects
- Polymer structure vs. processing (molding and drying)
- Resin additives, colorants, etc
- Fillers & reinforcements

January 22
- 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

January 29
- *Research proposal due at 7:30 p.m.*
- Research projects - *(SPE "Write now")*
- Sources of heat
  - Friction & Heating elements
- Sources of pressure
  - Mold design

February 5
- Sources of pressure (Colby "*Plasticating Components Technology")*
  - Screw forces and check valves
- Sources of shear
  - Screw & barrel design

February 12
- Sources of pressure
  - Hydraulic pumps & valves
  - Hydraulic fluid

February 19
- *Research bibliography due at 7:30 p.m.*
- Research update
- Midterm review

February 26
- *Midterm exam*

March 4
- Spring break

March 11
- Sources of cooling (*Engelmann & Dealey "Mold Design Guidelines")*
- Cooling system capacity and design
- Towers, chillers & pumps
- Water related issues, filters & treatment

March 18
- Mold wear vs. mold materials and coatings *(Wear articles)*

March 25
- Selection of variables in plastics processing
- Strategies to setup the process for a given mold
- Mold design integration to the molding process

April 1
- *TBD*

April 8
- *Research paper at 7:30 p.m.*
- Plastics process measurement

April 15
- Summary & Final exam review

April 22
- Final Exam