IND 320-06 — Fall 2023

Course Information

Course Title	Design Engineering I				
Course Number	IND 320	Section	06		
School	School of Design	Department	IND	Program	BID
Meeting Days	Thursday	Time	5-9:20pm	Location	ENG-202
Credit Hours	3				
Course Coordinator	Chamille Thayer				

Instructor Information

Name	Steve Faletti	Academic Title	Visiting Instructor
Email	sfaletti@pratt.edu	Office Hours	By Appointment

Course Description

Bulletin Description:

This course focuses on materials, manufacturing methods and the application of this knowledge to the practice of Industrial Design. The course will introduce commonly specified materials, their properties, costs, and impacts on sustainability and commerce. The course will also study the relationship of specific manufacturing methods on formal and aesthetic compositions as well as their relationship of these choices to markets, users and overall product feasibility.

Detailed Description:

This is a combination lecture/lab course covering the fundamentals of materials and manufacturing processes. Weekly lectures will be reinforced with digital modeling exercises directly associated to the lecture material. Topics will be introduced and discussed in terms of topology, mechanical properties, scale, sustainability and cost.

Course Goals:

- To become familiar with the range of commonly specified materials.
- To become familiar with the range of commonly specified production processes.
- To understand the impact of scale on cost.
- To understand the impact of scale on sustainability.

Student Learning Objectives:

Students will be able to...

- Specify suitable materials based on functional requirements.
- Specify suitable processes based on requirements of cost.
- Propose alternative materials and processes for a given design.
- Assess the relative impact of design choices on the environment.
- Present their implications of their choices visually using digital methodologies.

Course Schedule:

Week 1: Introduction & Subtractive Methodologies

Students will begin the basic principles of milling and other machining processes. Whether manual mill via bridgeport 3 axis process, up to modern 6 axis CNC via HAAS etc. EDM "Electrical Discharge Machining (Wire & Plunge)", its use cases and when one should or should not apply. Finally, "turning" via lathes and the benefits of each process. Discuss chip loading on end mills relative to material hardness.

Implications on metal, wood, and plastic: Which plastics are suitable for machining? Hardness relative to Steel and Aluminum.

Discussion of tooling cost and complexity vs cycle time and part cost.

Cad Demo and Assignment: Extrude & Revolve (additive and subtractive) Specific assignment should demonstrate understanding of difference between machined pockets and EDM (square corners, draft, etc as well as stress risers, difference in tooling setup between chamfer and radius edges. POSSIBLY a Fusion Milling simulation...

Week 2: Extrusion

Different types of extrusion. Straight extrusions. Open profiles vs closed profiles Tubing vs more engineered profiles. Micro extrusion (fiber).

Implications on metal, wood, and plastic. Nominal wall and material thickness vs cycle time and mechanical properties.

Discussion of tooling cost and complexity. Fixturing, stress relief,

Cad Demo: Extrusions for the product and lofted profiles for dies.

Week 3: Bending

The different types of bending. Cold bending, extrusion bending, dies etc.

Implications on Wood Plastic and Metal, wood is laminated or steamed, plastic must be heated, metal hot or cold...

Implications on metal, wood, and plastic.

Discussion of tooling cost and complexity

Cad Demo: Sweep and weldments. Specific assignment should demonstrate understanding material thickness to minimum bend radius, relief, springback. with configurations...

Week 4: Sheet forming (simple curves and bends, NO internal features)

Line bending, Brake forming, Rolling

Lamination process and its benefits and drawbacks. Lamination with natural products such as wood or lamination with composites I.E fiberglass, carbon fiber. Lamination via vacuum chamber, vacuum bag, autoclave. Wet vs dry lamination and different processes

Cad demo should introduce swept and extruded surfaces (thicken) vs shelling and sheet metal. Demonstrate understanding of thickness to bend radius, relief cuts,... Implications on metal, wood, and plastic. Lamination, line bending, brake forming, paper folding. Die cutting, waterjet cutting, laser cutting. CNC Router. Bend Radius vs material thickness. vs physical properties.

Discussion of tooling cost and complexity vs piece part cost & quantity.

Week 5: Sheet Forming (complex surface, No internal features)

Forming with metals. Stamping, hydroforming etc. Forming with plastics, vacuum forming, drape forming, Molded plywood

Implications on metal, wood, and plastic.

Discussion of tooling cost and complexity Cad demo should introduce lofted organic surfaces and reinforce thicken

Week 6: Forging

Forging metal. Heat working metal, tempering, shrinking and stretching. Where does the metal move if you are not removing metal? Stamping, Cold Forge vs Hot Forge,

Rolling Drawing, ERW Tubing vs DOM Tubing. Implications on and different Metals, Hardness, work hardening,

Implications on metal, wood, and plastic. Discussion of tooling cost and complexity Cad lab: As forged vs machined finished part...

Week 7: Rotational Molding and Casting

Different applications and best practices when it comes to rotational molding. Cost vs surface finish etc. Molding of polymers, Casting of exothermic resins. Reaction Injection Molding. Die Casting Aluminum. Structural features. Fastening features Parting lines. Imp,CERAMIC,WAX,LATEX DIP-MOLDING? Implications on metal, wood, and plastic. Discussion of tooling cost and complexity Cad Demo: Cavity/Cavity Molds. Draft Analysis. Silhouette split lines. Shell

Week 8: Midterm Exam

Series of Modeling problems and true false, multiple choice.

Week 9: Injection Molding 1 of 2

What the hell is injection molding? It IS that mythical beast that is a catch all for when you don't know what to say as a student. Mold types, Cycle time. Cooling, Mold flow. Side actions, Nominal wall. Draft.

Amortization, vs part quantity

Implications on metal ceramic and plastic.

Discussion of tooling cost and complexity

Cad Demo: Shell, Ribs, Bosses, Lip/Groove, Flow analysis.

Week 10: Injection Molding 2 of 2

Bi injection, Tri-injection Overmolding, Insert molding Structural features. Fastening features Parting lines

Implications on metal ceramic and plastic.

Discussion of tooling cost and complexity

Cad Demo: Multiple Bodies, Split parts, Assemblies

Week 11: Composites

Composites and its use cases. NOT just carbon fiber out there. Reinforce week 3. Expand the knowledge base of basic metal and plastics to composites such as glass fiber reinforced/carbon aramid injection molded polymer.

Internal features, bag technology, Wet vs dry layup. Hand vs automated methodologies. Cure times, Autoclaves etc.

Week 12: Studio Project Lab

Students will integrate what they've learned into their final studio project using the production processes, material knowledge and SolidWorks skills into realizing the final project for their main studio class.

Week 13: Studio Project Lab CAD LAB

Continuation of Week 13 lesson.

Week 14: Studio Project Lab CAD LAB

Continuation of Week 13 lesson.

Week 15: Final Exam Finals due.

Course Requirements

Textbooks, Readings, and Materials:

- *Making It: 3rd Edition*, Chris Leferti
- Materials and Design; Mike Ashby & Kara Johnson

Project(s), paper(s), assignment(s):

- CAD Projects 1-7
- 9 In class drawing quizzes.
- Final Design Studio Project Analysis
- Final Exam (TBD)

Assessment and Grading:

Your grade will be based on the following:

- Section participation 10%
- CAD Projects 20%
- Quizzes 20%
- Studio Project Analysis 25% Final exam 25% 100%

Standards for assigning course grades for example:

- A = sustained level of superior performance demonstrated in all areas of Course Requirements Page 5
- B = consistent level of performance that is above average in a majority of the Course Requirements
- C = performance that is generally average and Course Requirements are achieved
- D = below average performance and achievement of the Course Requirements
- F = accomplishment of the Course Requirements is not sufficient to receive a passing grade

Pratt Institute's Grading System can be found in the Undergraduate and Graduate Bulletins.

POLICIES

Institute-wide policies listed in the "Community Standards" section of the bulletin: This course adheres to all academic integrity, plagiarism, computer and network use policies, listed in the bulletin.

Pratt Attendance Policy:

There are no excused absences or cuts. Students are expected to attend all classes. Any absences may affect the final grade. Three absences may result in course failure at the discretion of the instructor. The attendance policy for this course will be consistent with the Institute Policy as stated above.

Policy on students with disabilities:

This course adheres to all Pratt policies on students with disabilities as listed in the bulletin. Students who require special accommodations for disabilities must obtain clearance from the Office of Disability Services at the beginning of the semester. They should contact Mai McDonald Graves, Director of Disability Resource Center, 718-802-3123. Any additional applicable school, departmental, or personal course policies:

Inclusion:

As a member of the Industrial Design faculty at Pratt, I am committed to supporting diversity and inclusion inside and outside of the classroom. I will endeavor to practice empathy, good listenership, patience, and openness to perspectives and contexts that are beyond my own. I hope that we can share the power to learn together while building towards a welcoming, rewarding, and supportive space for all. I seek to be flexible in my class to incorporate new understandings and lived experiences as they arise and encourage my students to do the same.