

Syllabus for: IENG 303

Manufacturing Processes Laboratory

Semester: Spring 2020

Credit Hours: 1.0

Prerequisite: Concurrent with IMSE 302

Course Description: A hands-on introduction to a variety of manufacturing processes. This course delves into the concepts and practice of design-for-manufacture through a series of introductory tutorial labs and a term-long design and fabrication project. Processes covered include CAD design, 3D printing, laser cutting, vacuum forming, soldering, CNC mill/turn, CNC plasma cutting, and MIG welding. A selection of additional processes will be available should student's projects require them. These include investment casting, injection molding, sheet metal forming, woodworking, and vacuum injection composites.

Instructor: Dr. Omar Al-Shebeeb

Email: oaalshebeeb@mix.wvu.edu

Office: ESB G85B

Phone: (304) 293-9432

Office Hours: by appointment

Teaching Assistants:

Name	Sections:	Email:
Assem Almadani	006, 013, 014, 015	ahalmadani@mix.wvu.edu
Andrew Engel	004, 008	ase0002@mix.wvu.edu
Austin Stern	002, 012	aes0004@mix.wvu.edu
Bridget Barrett	001, 003	bb0038@mix.wvu.edu
Clayton Cobb	007, 009	crc0028@mix.wvu.edu
Douglas Tompkins	011, 017	dwt0004@mix.wvu.edu
Fredricah Gardner	010, 016	fsgardner@mix.wvu.edu
Olivia Borta	005,	omb0001@mix.wvu.edu

Communications:

All course related email subject lines MUST follow the following format or they WILL NOT receive a response: "**IENG 303-00X, FirstName LastName, SUBJECT**". Emphasis - **Emails not following this format WILL NOT receive a response.**

Textbook: None. Manuals, documentation, and guides provided as links or PDF documents on eCampus.

Course Goals:

1. Introduce students to a variety of manufacturing and quality control processes.
2. Provide students with experience in design-for-manufacture using modern fabrication equipment.
3. Introduce students to collaborative CAD/CAM design environments.
4. Provide students with a hands-on and team-based design, prototyping, and testing experience utilizing the software and equipment introduced.

Learning Objectives:

Upon completion of this course students will be able to:

- Design a manufacturable part in CAD with an appropriate manufacturing process in mind throughout part design.
- Operate a basic FDM 3D printer to achieve the optimum strength/surface quality balance for a particular part.
- Operate a laser cutter system to mark and cut parts as appropriate. Select the appropriate power/speed/pass balance to achieve parts of the desired quality.
- Operate a 3-axis CNC milling machine using tool paths generated from a modern CAD/CAM package. Select the appropriate bit and feed/speed to achieve desired part quality.
- Operate a CNC Lathe using tool paths generated from a modern CAD/CAM package. Select the appropriate bit and feed/speed to achieve desired part quality.

Course Topics and Schedule*:

Week	Class Number	Notes	Class Topic	Guide Video(s) (Minimum Recommended Progress)	Individual Assignments (Due by Midnight of Your Class Day)	Term Project Deadlines (Due by Midnight Friday of week indicated <u>unless otherwise noted</u>)	Extra Credit Deadlines (Due by Midnight Friday of week indicated)
01/13/20	1		Welcome, Safety, Intro Assessment, Begin CAD	1, 2, 3, 4, 5		Intro Assessment Due: By midnight day-of-class	
01/20/20	2	No Class M, MLK Day Recess	CAD for Laser Cutting, Term Project Assignment	4, 5, 6, 7, 8		Project and Teams Assigned	Intro Safety & Toolbox Quiz Due
01/27/20	3		CAD for Laser Cutting, Laser Cutter Operation	9, 10, 11, 12			
02/03/20	4		3D Scanning Demo, CAD for 3D Printing	13, 14	Laser Cutter Project Due	Status Report 1 Due	
02/10/20	5		CAD for 3D Printing, Part Slicing	14, 16			
02/17/20	6		Vacuum Forming, Soldering	17, 18	3D Print STL Files Due		Laser Cutter Re-Design
02/24/20	7		Vacuum Forming, Soldering	17, 18	3D Print & Scan Project Due	Mockup Due	
03/02/20	8		CNC Machining CAD & Toolpath Generation	19, 20, 21	Vac Form & Soldering Project Due		
03/09/20	9		CNC Machining Operation 1	21, 22, 23			3D Print Re-Design
03/16/20	-	Spring Recess	-	-	-	-	-
03/23/20	10		CNC Machining Operation 2	22, 23	CNC Machining - Toolpath Sim Due		
03/30/20	11		CNC Machining Operation 3	22, 23		Functional Prototype Due	
04/06/20	12	No Class F: Spring Holiday	Plasma Cutting CAD and Toolpath Generation	24	CNC Machining Project Due		
04/13/20	13		Welding & Plasma Cutting 1	24, 25, 26			
04/20/20	14		Welding & Plasma Cutting 2	25, 26			Machining Re-Design
04/27/20	15		Welding & Plasma Cutting 3	25, 26	Welding Project Due	Final Poster: Wednesday 04/29 Final System Demo: Friday 05/01	
05/04/20	16	FINALS WEEK	-	-	-	-	-

* Schedule is subject to revisions depending on equipment operational status

Course Contribution to Professional Component:

Engineering Topics – 100%. This course contains 10% design content.

Grading Structure+:**

Design and Fabrication Projects (5x, individual work)	50%	(5x @ 10%/ea)
Term-long Team System Design Project	50%	(See breakdown below)
Bonus Options:		
Intro Extra Credit Quiz	0.5%	
Individual Project Re-Design/Builds	6%	(3x @ 2 %/ea)
Early Submission Bonus	4%	(2x @ 2%/ea)
Maximum Possible Score:	110.5%	
Term Project broken down as follows:		
Status Report	8%+	(2% peer eval)
Mockup	8%+	(2% peer eval)
Proof of Concept Prototype	8%+	(2% peer eval)
Final Poster & Performance Demo	8%+	(2% peer eval)
Final System Demo	8% +	(2% peer eval)

*Note, all late assignments will receive a 1%/day penalty (10 point/day).

%Note, all students may miss two days of class at no penalty. For absences beyond that a 2.5%/day penalty will be assessed.

*Note, all percentages shown are % of final grade.

Design and Fabrication Projects:

Each major section of the course features its own Design and Fabrication Project. They begin with an introduction to the process, a discussion of the capabilities and limitations of the process in question, and a set of constraints for the student to design within. Appropriate CAD design methods are introduced. Students then design their own introductory parts considering the process capabilities and imposed constraints. The following class each student's piece(s) will be manufactured using the process. Following part/assembly fabrication the students will be asked for lessons learned, specific design or fabrication process changes that would improve results, as well as part dimensional tolerances and percent error in fabrication. Detailed rubrics and assignment documents are provided for each of the projects

Term Project:

Teams will be assigned by the instructor based on the results of a non-graded survey. A best effort will be made to distribute students such that each team has a relatively even group of majors and self-assessed prior experience with CAD design and fabrication. CAD design work MUST be done in Autodesk Fusion 360.

Students will be expected to purchase some components and materials for their projects. The project has been designed such that the per-student out-of-pocket expenditure should be under \$50. The instructor will provide a representative list as a guideline from which to work. Students in financial hardship should approach the instructor privately to arrange for loans of the equipment if necessary. Separate from the student out-of-pocket expenditure the shop will provide each team with a budget for shop-provided materials and a cost structure for same.

CAD Software:

This class uses the Autodesk Fusion 360 CAD package. Students may create an account and download this software for free from (<http://www.autodesk.com/products/fusion-360/students-teachers-educators>). Students are required to use this software for their designs as it will be a primary collaboration and communication tool for the term design project.

Fusion 360 is also available on the ESB G85 shop computers as well as in the following computer labs:

- ESB G3, G11, G78B, 225, 231, 239, 249
- AER 137 (Fusion 360 auto updating may be unstable in this lab)
- MRB 243
- IMSE Undergrad & grad labs on ESB 3rd floor and MRB 340

Attendance:

Laboratory attendance is MANDATORY. Students may skip up to two (2) classes with no penalty. After that point the final grade will be reduced by 2.5% per absence.

Academic Integrity Statement

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, instructors will enforce rigorous standards of academic integrity in all aspects and assignments of their courses. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the West Virginia University [Academic Standards Policy](http://catalog.wvu.edu/undergraduate/coursecreditstermsclassification) (<http://catalog.wvu.edu/undergraduate/coursecreditstermsclassification>). Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see your instructor before the assignment is due to discuss the matter.

Academic Standards Policy, including Academic Dishonesty

The WVU Catalog contains the full [Academic Standards Policy](#).

[Resources for Faculty and Students for Reporting and Appealing Violations of Academic Standards](#)

The policy of this course is discussed in detail beginning on Page 6 of this document.

Adverse Weather Statement

In the event of inclement or threatening weather, everyone should use his or her best judgment regarding travel to and from campus. Safety should be the main concern. If you cannot get to class because of adverse weather conditions, you should contact your instructor as soon as possible. Similarly, if your instructor(s) are unable to reach the class location, they will notify you of any cancellation or change as soon as possible, using agreed upon methods to prevent students from embarking on any unnecessary travel. If you cannot get to class because of weather conditions, instructors will make allowances relative to required attendance policies, as well as any scheduled tests, quizzes, or other assessments. [adopted 9-8-2014]

Campus Safety Statement

The WVU Police are committed to creating and maintaining a safe learning environment for all students, faculty, and staff. Part of this mission includes educating the campus community on how to respond to potential campus threats, such as the threat of an active shooter on campus or other suspicious behaviors. Fortunately, WVU Police offer training - both online and in-person - on how to handle a variety of campus safety scenarios. All students are encouraged to visit the [WVU Police](https://police.wvu.edu/) (<https://police.wvu.edu/>) webpage, in particular the content under the [Active Shooter](https://police.wvu.edu/training) (<https://police.wvu.edu/training>) training program. Students are also encouraged to report any suspicious

behaviors on campus using the [Report a Threat](https://police.wvu.edu/emergency-management/threat-assessment) (https://police.wvu.edu/emergency-management/threat-assessment) portion of the webpage. Additional materials on campus safety prepared by WVU Police, including special safety tips and training, will also be provided on our eCampus page. [adopted 10-2-17]

Inclusivity Statement

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in your classes, please advise your instructors and make appropriate arrangements with [the Office of Accessibility Services](https://accessibilityservices.wvu.edu/). (https://accessibilityservices.wvu.edu/)

More information is available at the [Division of Diversity, Equity, and Inclusion](https://diversity.wvu.edu/) (https://diversity.wvu.edu/) as well. [adopted 2-11-2013]

Incomplete Policy

The WVU Catalog contains the full [Incomplete Policy](#).

Sale of Course Material Statement

All course materials, including lectures, class notes, quizzes, exams, handouts, presentations, and other course materials provided to students for their courses are protected intellectual property. As such, the unauthorized purchase or sale of these materials may result in disciplinary sanctions under the [Student Conduct Code](#). (https://studentconduct.wvu.edu/policies-and-procedures) [adopted 5-11-2015]

Sexual Misconduct Statement

West Virginia University does not tolerate sexual misconduct, including harassment, stalking, sexual assault, sexual exploitation, or relationship violence [[BOG Rule 1.6](#)]. It is important for you to know that there are resources available if you or someone you know needs assistance. You may speak to a member of university administration, faculty, or staff; keep in mind that they have an obligation to report the incident to the [Title IX Coordinator](#). (https://titleix.wvu.edu/staff)

If you want to speak to someone who is permitted to keep your disclosure confidential, please seek assistance from the [Carruth Center](#), 304-293-9355 or 304-293-4431 (24-hour hotline), and locally within the community at the [Rape and Domestic Violence Information Center](#) (RDVIC), 304- 292-5100 or 304-292-4431 (24-hour hotline).

For students at WVU-Beckley, contact the [Women's Resource Center](#) at 304-255-1585 (toll free at 1-888-825-7836) or [REACH](#) at 304-340-3676. For students at WVU-Keyser, contact the WVU-Keyser [Psychological Services Office](#) at 304-788-6976, and locally in Keyser, the [Family Crisis Center](#), 304-788-6061 or 1-800-698-1240 (24-hour hotline).

For more information, please consult [WVU's Title IX Office](#) (https://titleix.wvu.edu/confidential-resources).

Student Evaluation of Instruction Statement

Effective teaching is a primary mission of West Virginia University. Student evaluation of instruction provides the university and the instructor with feedback about your experiences in the course for review and course improvement. Your participation in the evaluation of course instruction is both strongly encouraged and highly valued. Results are strictly confidential, anonymous, and not available to the instructor until after final grades are released by Admissions and Records. Information about how you can complete this evaluation will be provided by your instructor. [adopted 4-14-2008]

Academic Dishonesty:

From WVU policy available at the following web page as of June 28, 2016 (6/28/2016).

(<http://catalog.wvu.edu/undergraduate/coursecreditstermsclassification/#academicintegritytext>)

"The term "academic dishonesty" means plagiarism; cheating and dishonest practices in connection with examinations, papers, and/or projects; and forgery, misrepresentation, or fraud as it relates to academic or educational matters.

1. The term “**plagiarism**” means the use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgment, including, but not limited to, the unacknowledged use of materials prepared by another individual engaged in the selling of term papers or other academic materials.
2. The terms “**cheating and dishonest practices in connection with examinations, papers, and/or projects**” means (i) giving or receiving of any unauthorized assistance in taking quizzes, tests, examinations, or any other assignment for a grade; (ii) depending upon the aid of sources beyond those authorized by the instructor in quizzes, tests, examinations, writing papers, preparing reports, solving problems, or carrying out other assignments; (iii) the acquisition or use, without permission, of tests or other academic material belonging to a member of the University faculty or staff; or (iv) engaging in any behavior specifically prohibited by a faculty member in the course syllabus or class discussion.
3. The terms “**forgery, misrepresentation, or fraud as it relates to academic or educational matters**” means (i) wrongfully altering, or causing to be altered, the record of any grade or other educational record; (ii) use of University documents or instruments of identification with the intent to defraud; (iii) presenting false data or information or intentionally misrepresenting one’s records for admission, registration, or withdrawal from the University or from a University course; (iv) knowingly presenting false data or information or intentionally misrepresenting one’s records for personal gain; (v) knowingly furnishing the results of research projects or experiments for the inclusion in another’s work without proper citation; or (vi) knowingly furnishing false statements in any University academic proceeding.”

Penalties for any of the above in this course:

First Offense: Unforgivable 0% on the current assignment with written warning provided for student’s and instructor’s files.

Second Offense: Failure of course.

SAFETY INSTRUCTIONS

Appropriate clothing is required. Should you arrive at the lab in improper attire you will not be permitted to participate. This will be treated as a SKIPPED CLASS.

Safety is the ONLY criteria on which the acceptability of attire is based.

SAFETY CULTURE:

Promoting and maintaining safety depends on everyone's individual behavior: shop users, shop staff, and university administration. Everyone is expected to keep an eye out for other shop users, as well as themselves, to teach and to caution when required. This depends on mutual respect and clear communication between all parties. Everyone can make mistakes, and everyone can learn. If you have a concern about the methods or process in use at any time please ask the person(s) involved.

ATTIRE REQUIREMENTS:

General Shop:

Shoes: Closed-toe, laced or similar with rubber soles for traction. No slippers/sandals permitted. No high heels/platform soles.

Pants: Long pants. No skirts, shorts, dresses, kilts, leggings/sweatpants. No holes/ripped-look.

Shirts: At minimum must cover full torso with no holes. Suggest cotton T or similar with closed collar. Short-sleeved shirts are strongly recommended to reduce risk of snagging.

Eyes: Safety glasses must be worn at all times in the lab. Safety glasses are provided at the entry door.

Hair: Long hair must be tied back/up.

Jewelry: Rings, bracelets, watches, necklaces, neckties, and dangling ear rings must be removed and stored.

All clothing must fit well. Neither excessively tight and binding nor baggy/flowing which may be caught in machinery.

Food/Drink: Not permitted in the shop area, even if remaining in backpacks. A space is provided at the entry door for storage.

Additional safety information is provided on the information card attached to each machine.

Hot Works: All General Shop Requirements unless otherwise noted

Shoes: Leather upper with rubber sole. No mesh, holes, etc.

Pants: Must be Natural Fiber (cotton, wool, etc.) and meet all General Shop requirements.

Shirts: Welding jackets are provided and must be worn. Long-sleeve Natural Fiber (cotton, wool, etc.) shirts underneath are strongly encouraged.

Eyes: Welding goggles/hoods must be used while equipment is in operation in addition to safety glasses.

Additional safety gear will be provided as appropriate to the section you are working in.

Food, Drink, and Personal Items:

Storage shelves have been provided at the front of the G85 shop to keep backpacks and bags. Any food or drink brought into the shop must be stowed in that area.

Innovation Hub Shop/Tool Use Safety Agreement

All shop users must complete and sign this form. Shop Supervisors are to keep this form on file. See reverse for records of tool authorizations and course completions.

Name (last / family)	Name (first / personal)	WVUID	Date
Email Address		College	Department
Status:			
Student – Undergraduate	Student – Graduate	Faculty/Staff	
External – Business	External –Private		

I have read the following guidelines and, and understand them as they apply to my work in the shop/lab areas. Specifically:

1. I agree to abide by the published and posted regulations and accept personal responsibility for my work in the WVU Innovation Hub. I will abide by any and all Innovation Hub rules. I understand that my failure to do so can result in my loss of access to the Innovation Station.
2. I will wear safety glasses at all times while in the shop.
3. I understand what attire is required to work in the shop and will not enter the shop unless so attired.
4. After use I will clean and maintain all equipment, floors, and benches I use.
5. I will not attempt to use any machine, tool, or equipment that I do not have written permission to use. I will ask for instruction and/or training before using any machine, tool or equipment with which I am not familiar.
6. I will check in with shop staff upon entering or leaving the shop, and prior to operating any machinery.
7. For any equipment or tooling I find needing repair, or that is damaged while I am operating it, I will promptly notify the monitor or supervisor and I will leave a prominent cautionary note on the machine listing my name and phone number or email address where I can be contacted.

CERTIFICATION: I understand that it is a privilege and a learning opportunity to use the shop/lab areas and agree to abide by all University regulations and stipulations placed upon me as conditions for working in these areas.

Signed:	Date
----------------	-------------