

ME345: Automation & Manufacturing Methods

Fall 2023

Instructor and Class Information

Instructor: J. William (Will) Boley, Assistant Professor in the Department of Mechanical Engineering and Division of Materials Science and Engineering, jwboley@bu.edu, (859)-391-8637

Office Hours: Mon 12:00 PM - 1:00 PM, or by appointment - please arrange via email or in person directly following lecture

Office Location: 730 Commonwealth Ave, Rm 214

Lecture Times, Location: Mon & Wed 2:30 PM - 4:15 PM (EPC 207, 750 Commonwealth Avenue)

Graduate Student Teachers (GSTs):

- Ahmad Ahmad, ahmadgh@bu.edu, Instructs labs C1 (Tue 12:30 - 3:15 PM), C4 (Thu 8:00 - 10:45 AM), and C9 (Thu 3:30 - 6:15 PM)
- Anissa Benzaid-Williams, benzaid@bu.edu, Instructs lab C7 (Fri 8:00 - 10:45 AM)

Lab Supervisors:

- Adam Zelny zelnya@bu.edu, Instructs lab C3 (Tue 8:00 AM - 10:45 AM)
- Caroline Carbo, ccarbo@bu.edu, (617)-358-1691, Instructs pre-lab lectures and GibbsCAM tutorial

Lab location, Hours: 750 Comm Ave (EPIC), See EPIC Website for hours

Prerequisites: ME357: Introduction to CAD and Machine Components, EK210: Introduction to Engineering Design, and EK122/EK125: Programming for Engineers, or approval of instructor

Course Website: <http://learn.bu.edu>

Course Description:

This course introduces the major concepts and practices of modern manufacturing, including computer numerically controlled (CNC) machine programming, robotic programming, scheduling, real-time process control, digital imaging and machine vision, programmable logic control (PLC), statistical process control (SPC), production system design (LEAN), and computer-based process simulation. Strong emphasis is given to hands-on laboratory experience, with a lecture component that covers fundamental concepts and supports the laboratory exercises. The lab (link [here](#)) is comprised of a flexible manufacturing cell (FMC) in the Automated Design and Manufacturing Laboratory (ADML) within EPIC. During the labs the students will learn individual system components and then how to integrate the components together to program an automated manufacturing sequence that produces multiple physical products. For the course project the students will combine everything learned over the semester to introduce a new product of each team's own design that provides a positive societal impact and demonstrate that their design can be automatically manufactured by the ADML's FMC with the goals of maximizing yield and throughput. 4 credits.

Course Objectives

1. Introduce tools, principles, and methods, used in modern manufacturing.
2. Acquire practical experience in computer-aided manufacturing (CAM) and manufacturing process development through a series of laboratory exercises.
3. Understand the strategies and methods used to optimize production system design & operations.
4. Support a team effort to design & manufacture a product with the ADML FMC.

Required Reading

- Selected readings from *Fundamentals of Modern Manufacturing*, M. P. Groover, John Wiley & Sons, Inc., 6th Edition (2016), posted to Blackboard.
- Selected readings from *Operations and Supply Chain Management*, F. Robert Jacobs and Richard B. Chase, McGraw-Hill Education, 15th Edition (2018), posted to Blackboard.

- *Other readings (articles, excerpted material, etc)* posted to Blackboard.
- *Lecture slides* posted to Blackboard.
- *Lab manuals* posted to Blackboard (read prior to lab).

Grading:

1. Labs (pre-lab questions 25%, lab reports 75%): [30%]
2. Homework (four total) [20%] (Weighted equally)
3. Mid-term Exam* [20%] (Based on lectures, exercises, homework, discussions, labs, reading, etc.)
4. Course Project (based on degree of completeness, level of effort, presentation and reports) [20%]
5. Class & Lab Attendance, in-class exercises, project team and lab partner feedback, quizzes and participation [10%]

Labs:

- Each lab will take place in the EPIC Automated Design and Manufacturing Laboratory (ADML) facility (EPC 101, 750 Comm Ave). Students are expected to attend the full duration of their lab and actively participate, along with their lab partners.
- In order to access that facility, you must take and pass the EPIC Safety quiz: <https://www.bu.edu/epic/get-started/safety-quiz/>.
- Students in each lab section will split up into sub-groups of 2 lab partners. For lab sections with an enrollment of an odd number of students, there will be one group of 3 lab partners, with the remaining students being in groups of 2. Each group will be responsible for doing each lab as a team *except for* labs 1 (CNC Milling), 6 (Computer Integrated Manufacturing (CIM) Part I), and 7 (CIM Part II). For lab 1, each student will go through the lab procedure individually under the guidance of their lab instructor. For Labs 6 and 7 all students in each lab section will work as a larger team (super group) to perform the lab.
- Students must submit their **individual** pre-lab answers on Gradescope by 5:00 PM three days prior to their corresponding lab *except for* lab 6 (CIM Part I), which is to be submitted by the super group.
- Lab reports are expected to be submitted online through Gradescope as a Word document within one week after the corresponding lab session. Lab reports will be submitted as a team, one submission per sub-group, with the exception of Lab 6, where one lab report will be submitted for the entire super group.

Course Project:

The course project entails the manufacture of a **new** product that **positively impacts society** using the automated assembly line in the ADML. This project includes six components: 1) Design of the product and its parts, 2) Development of manufacturing strategy and processes, 3) Computer integrated manufacturing (CIM) control, 4) Scheduling, 5) Implementing Lean principles, and 6) Cost estimation. Your lab group will be all the students in your specific lab section. More details of the project can be found in the project description, available on Blackboard. The detailed instructions and the rubrics for project assignment will be presented during lectures and will be available on Blackboard.

General Class Policies

1. **Attendance:** Attendance and participation in all lectures and labs are expected and are factored into the grade (10% of your total grade, and includes lecture, lab, and project participation). Any absences of lectures or labs that are within reason must be communicated by the student to the course and lab instructors in advance. 14.3% and 12.5% of possible attendance points will be deducted for every 15 minutes a student is late for each lecture or lab, respectively. The student is also responsible for working with the course and lab instructors and their lab teammates on how to make up any assignments or other work that may be affected by the absence. Some lectures throughout the semester will include breakout group work. To accommodate this on those specific lecture days, students are strongly encouraged to sit in desks adjacent to the classmates that are in the same lab section, and to be active participants.

2. **Making Up Assignments:** Make up of missed work permitted only with approval **before** the scheduled due date/time, otherwise the assignment is considered late.
3. **Late Assignment Grade Deductions:** With the exception of pre-lab assignments and the GibbsCAM checklist for the project prototypes, any late assignments will be receive deductions of 3% if submitted on the due date but after the time it is due. The following deductions will be applied if submitted after the due date. A 5% deduction per day late for the first 2 days, followed by an additional 10% per day late for the next 2 days, then an additional 20% per day late for the next 2 days, and an additional 30% for the 7th day (i.e., students will receive no credit for anything submitted a week late). For the pre-lab assignments and GibbsCAM checklist for the first project prototypes, late assignments will receive deductions of 20% if submitted on the due date but after the time it is due. An additional deduction of 30% will be incurred for each day after the due date until 5:00 pm two days after the due date (i.e., students will receive no credit for anything submitted after 5:00 pm two days after the due date). This is to allow lab instructors and graders to review the corresponding GibbsCAM and to prepare feedback for the students so that any errors can be addressed in the lab in a timely manner.
4. **Grade Queries:** It is the student's responsibility to ensure that all assignments have been recorded correctly (assignments receiving a 0 due to late or non-submitted assignments do not apply to this). Students have two weeks to review graded work and contact the course instructor about any requested changes. No change in grade will be permitted after this two week period.
5. **Electronic Device Policy:** Non-ME345 electronic devices (including but not limited to cell phones or laptops) use in lab and class is prohibited; repeat offenses will result in a grade penalty. Devices for taking notes (e.g., tablets or iPads) are acceptable.
6. **Academic Conduct Statement:** Students must follow the BU Academic Conduct Code: <https://www.bu.edu/academics/policies/academic-conduct-code/>. Any violation of this conduct code will be reported to the College of Engineering Academic Conduct Committee. This includes plagiarism, defined by Merriam-Webster as: "to steal and pass off (the ideas or words of another) as one's own." Students should take care to cite any source they use and ensure anything they hand in as their own is their own original work.
7. **Inclusion:** I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.
8. **Accommodations for Students with Documented Disabilities:** If you are a student with a disability or believe you might have a disability that requires accommodations, requests for accommodations must be made in a timely fashion to Disability & Access Services, 25 Buick St, Suite 300, Boston, MA 02215; 617-353-3658 (Voice/TTY). Students seeking academic accommodations must submit appropriate medical documentation and comply with the established policies and procedures (<http://www.bu.edu/disability/accommodations/>.)