

Fall 2020

## **ME 215-009: Engineering Materials and Processes**

Shawn Chester

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MECHANICAL ENGINEERING  
 NEW JERSEY INSTITUTE OF TECHNOLOGY  
 ME215 Engineering Materials and Processes Course Syllabus  
 Fall 2020

Updated: August 29, 2020 with modifications and specific details for remote / converged learning due to the SARS-CoV-2 virus are shown in red

*It is the responsibility of the student to read and understand this course syllabus. This syllabus is subject to change and may be updated throughout the semester.*

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# 1 Course Summary

## 1.1 Course Description

This course introduces the student to a combined lecture and laboratory related to engineering materials and processes. Engineering materials considered include, but are not limited to, metals, ceramics, and polymers. Processes, and how they affect properties, include but are not limited to, the formation of a part from a molten/particle state, forming, material removal, heat treatment, and additive manufacturing. Laboratory exercises involve, but are not limited to, basic machine tools, measurements, microstructure identification, and computer controlled equipment.

## 1.2 Credits and Contact Hours

This course is 3 credits, with 2 lecture contact hours and 2 laboratory contact hours.

## 1.3 Prerequisites

CHEM 126 or CHEM 122.

## 1.4 Text

(Required text) J.T. Black, R.A. Kohser. DeGarmo's Materials and Processes in Manufacturing, 13th Ed., John Wiley & Sons Inc., 2019.

(Lab manual) ME 215A: R. Dubrovsky: Engineering Materials and Processes. (Available on Canvas.)

## 1.5 Class Times and Delivery

Section	Lecture	Lab	Lecture mode of delivery
001 & HM1	Asynchronous online	Fri. 1:10-3:15pm MEC232	Hybrid
003	Asynchronous online	Tue. 12:30-2:35pm MEC232	Hybrid
009 & HM3	Asynchronous online	Thu. 9:00-11:05am MEC232	Hybrid
011	Asynchronous online	Tue. 9:00-11:05am MEC232	Hybrid
101	Tue. 6:00-7:55pm	Tue. 8:05-10:00pm MEC232	Synchronous online
103	Wed. 6:00-7:55pm	Wed. 8:05-10:00pm MEC232	Synchronous online

Please note that sections designated as hybrid will never meet face-to-face for lecture. The lecture will be held asynchronously online since the registrar has not designated a room or time. Also, we would like to remind students that a hybrid class maintains the same expectations and rigor of a face-to-face class. Please manage your time and effort appropriately, and we encourage students to reach out during laboratory classes and during office hours if you are in need of assistance.

**Updated for remote / converged learning due to the SARS-CoV-2 virus:** Following the NJIT Pandemic Recovery Plan,<sup>1</sup> we have the following details related to the various phases of recovery that may be encountered this semester.

- For synchronous online lecture classes, WebEx meetings will be conducted.
- For all laboratory classes, for safety reasons during the pandemic, we cannot run full laboratory modules face-to-face, therefore WebEx meetings will be conducted. Every single laboratory module either employs a single piece of equipment, components are shared among students, or equipment is located in a physically small room. Additionally, for the Fall 2020 semester, all sections are at least 50% overloaded, and we are unable to safely provide an opportunity for all students to participate face-to-face. Therefore the only safe course of action is to run the laboratory remotely, with an opportunity for a hands on experience for the most safe laboratory. Expanded details for the laboratory are provided in Section 3.6 and the decision making rationale in Section 4 later in this syllabus.

## 2 Instructional Team

### 2.1 Instructors

Section(s)	Instructor	Office	Email
001 & HM1 & 003	Prof. Veljko Samardzic	MEC325	samardzi@njit.edu
009 & HM3 & 011	Prof. Shawn Chester	MEC305	shawn.a.chester@njit.edu
101 & 103	Prof. Naruemon Suwattananont	MEC324	ns48@njit.edu

### 2.2 Teaching Assistants

Abhishek Mukherjee (am2455@njit.edu)    Yassine Tissaoui (yt277@njit.edu)  
Mahan Mahdavi (mm69@njit.edu)        Joy Datta (jd82@njit.edu)  
Abdullah Mamun (sm268@njit.edu)

<sup>1</sup>The NJIT Pandemic Recovery Plan may be found online [here](#).

## 2.3 Office Hours

Instructors will inform their section(s) of their office hours in the class. Also, office hours for individual instructors are posted in the department office.

**Update for remote / converged learning due to the SARS-CoV-2 virus:** In place of typical in person office hours, office hours will be held using WebEx. Details will be determined in each specific section individually.

## 3 Course Policy

### 3.1 Communication

This course will make use of Canvas for dissemination and collection of various materials. Also, you will be regularly contacted via Canvas and/or email at your NJIT email address.

There have been increasing numbers of student emails from personal accounts that have been flagged as spam. Accordingly, please do not use personal email accounts since the instructors may never respond to that email.

### 3.2 Repeat Students

Students repeating the course are required to repeat the entire course. Assignments, laboratory practices, exams, and laboratory reports cannot be transferred from previous semesters.

### 3.3 Honors Students

For those registered for an honors section of this course, an extra laboratory and corresponding report will be assigned to earn honors credit. The specific date of the honors lab will be determined in the later half of the course.

### 3.4 Course Learning Objectives and Performance Criteria

Students are expected to gain a basic working knowledge of engineering materials and manufacturing processes, through combined lecture and laboratory exercises. The specific objectives and performance criteria are:

1. Design new alloys, or select an alloy for a required application. Evaluated on exams and reports: 80% of the students will earn a grade of 75% or better.
2. Select a desired material based on the design. Evaluated on exams and reports: 80% of the students will earn a grade 75% or better.
3. Describe the mechanical properties of different engineering materials. Evaluated on reports and the library research assignment: 80% of the students will earn a grade of 75% or better.
4. Select a material and sequence of manufacturing processes for a desired application. Evaluated on reports: 80% of the students will earn a grade 75% or better.
5. Plan the sequence of operations in order to achieve final part configuration. Evaluated on reports: 80% of the students will earn a grade 75% or better.

6. Explain the manufacturing process required for achieving desired part configuration. Evaluated on exams: 80% of the students will earn a grade of 75% or better.
7. Define tolerances, allowance, and the difference between clearance and allowance. Evaluated on exams and reports: 80% of the students will earn a grade 75% or better.
8. Select the required tolerance using tables in the system of limits and fits. Evaluated on exams and reports: 80% of the students will earn a grade 75% or better.
9. Use different measuring tools and equipment to take readings from them with required accuracy. Evaluated on lab exercises and reports: 80% of the students will earn a grade 75% or better.

### 3.5 Exams

For all sections Exams 1 and 2 will be common exams that take place on Monday 4:15-5:45pm, Exam 1 will be on 10/5, and Exam 2 will be on 11/2, and the room assignments will be announced in class. The final exam will also be a common exam, the time and place announced by the registrars office. For conflicts, we follow the NJIT policy for final exams provided online. The policy generally indicates that the course with the higher numerical value takes place during the regularly scheduled period.<sup>2</sup>

The NJIT honor code will be upheld and any violations will be brought to the attention of the dean of students. Only non-programmable calculators are allowed during exams. *Mobile phones, smart watches, programmable calculators, and similar electronic devices are expected to remain out of sight — the sight of a mobile phone, smart watch, or programmable calculator during an exam results in a grade of F for the class.* The exam materials consist of two documents, a question booklet, and an answer sheet. Please note the answer sheet is the only thing that will determine the grade, not what is in the exam booklet. Failure to show for an exam results in a grade of zero and employment is not considered a valid reason for missing an exam.

The NJIT best practices related to academic integrity, which may be found [here](#), indicates that makeup exams “should not be administered unless an unforeseen extraordinary circumstance . . . prevents a student from taking an exam at the designated time.” We adhere to that practice, and NO MAKEUP EXAMS WILL BE GIVEN, and only one appropriately excused exam absence accommodation is possible per semester per student. The typical accommodation for an appropriately excused absence is to have other grades from the semester scaled by the mean and standard deviation of the normal distribution fitted over the entire course, and used in place of the missing exam score.<sup>3</sup> In the case that a student is absent (or expects to be absent) for an exam, the following actions are required in order for that exam grade to be non-zero:

1. The student should write an email to the professor indicating that he/she is going to contact the dean of students office about their absence from the exam. The dean of students office may be contacted at dos@njit.edu. Those expecting official travel (i.e., athletes, academic conferences, etc.) must notify the professor and the dean of students office at least 2 weeks prior to the exam. In extreme cases (i.e., unforeseen sickness, death, etc.) the student must notify the professor and dean of students office within 48 hours after the originally scheduled

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<sup>2</sup>This paragraph does not apply to summer courses, where exam details are handled in each class.

<sup>3</sup>As an example, a student missing Exam 2, labelled “ $E$ ”, may be replaced by the final exam score, labelled “ $F$ ”, through  $\frac{E_2 - \bar{E}_2}{\sigma_2} = \frac{F - \bar{F}}{\sigma_F}$ , where “bar” values are the mean, and  $\sigma$  values are the standard deviation. Therefore the scaled missing exam score will be determined by  $E = \sigma_E \left( \frac{F - \bar{F}}{\sigma_F} \right) + \bar{E}$ .

exam time. In the email sent to the dean of students office, students should at a minimum include the following: (i) name; (ii) ID number; (iii) course and section; (iv) professor's name and email; (v) regularly scheduled exam time; (vi) valid evidence for the unforeseen extraordinary circumstance that caused absence.

2. Upon receiving notice from the dean of students office, the professor will contact the course coordinator and provide the relevant information.
3. Since it is likely that multiple students across different sections are in a similar situation, the course coordinator will make a decision that is equitable to everyone involved.

Typically for final exams, if appropriately excused, a grade of incomplete is given if appropriate.

For those students that will make use of the NJIT Office of Accessibility Resources and Services (OARS), please make note that OARS requires accommodation requests must be submitted no later than 3 business days prior to the exam date. However, if the instructors do not receive at least 2 business days notice, we cannot guarantee any OARS accommodation and the exam should be taken normally. Therefore, we encourage students that makes use of OARS accommodations to do so in a timely manner such that you are well before the deadlines.

**Update for remote / converged learning due to the SARS-CoV-2 virus:** Exams will be conducted remotely online and require the Respondus LockDown browser coupled with a webcam. However the times and dates remain the same for the common exams. All sections, day and night, take the common exam all together at the same time, specifically, Monday 4:15-5:45pm, where *Exam 1 will be on 10/5, and Exam 2 will be on 11/2*. To make sure that everyone is well prepared, an ungraded practice exam will be administered so that any technical difficulties may be worked out prior to the exam.

A few general comments about online exams using the LockDown browser:

1. When it comes to showing your environment, please do so completely, include the entire room and your desk space, including under your desk. We are looking for phones, smart watches, other computers, other people, etc. If you do not show the room completely we must assume the worst, we are really looking. We have posted content on canvas to clarify the environment check and our expectations.
2. If you encounter technical issues, students must work through the IST Service Desk.
3. If you do not have appropriate hardware, students must contact the dean of students office, well before the exam date.
4. Scratch paper is not allowed.
5. The format of the online exam questions may not be the same as previous semester the face-to-face exam questions.

Lastly, instructors and TAs have neither the in-depth knowledge nor the admin rights to help resolve any technical issues. If issues arise, students must work through the IST Service Desk. Additionally, if you do not have the appropriate equipment, you must contact the dean of students office. Do not contact instructors or TAs, we will only direct you to either the IST Service Desk or the dean of students office.

### 3.6 Laboratory and Laboratory Reports

Safety in the laboratory is a high priority – students are required to wear safety glasses at all times in the laboratory an experiment is being performed.

Laboratory attendance is mandatory, students are required to complete all laboratory practices and submit all corresponding laboratory reports to pass the course. Further, if more than 15 minutes late, credit will not be given for that laboratory practice and a makeup must be taken (*more details below*). *Pre-lab quizzes are given in the first 15 minutes, these simple quizzes serve to take attendance, as well as ensure that students have read the manual prior to the lab.* Students that miss a laboratory practice are required to makeup that experiment by going to another section that semester (*see the details below*). Employment is not considered a valid reason for missing lab.

Laboratory reports are due one week (specifically five working days, e.g., a lab experiment completed on a Monday, is typically due the following Monday) after the experiment is finished.<sup>4</sup> Lab reports are to be *submitted electronically via Canvas as a single PDF file. Any other method is not an appropriate method to submit, and therefore not graded.* Each day a laboratory report is late 10% is taken off the maximum allowable grade. Therefore a perfect lab report will get 50% credit if it is submitted 5 days late. After 10 days the report will have zero value, however will show on the record as being submitted. Keep in mind that holidays and weekends are not ignored in the late policy, they count as days. Note that reports with incomplete or missing cover pages are considered unprofessional, and a 50% deduction will be taken.

For lab reports, lateness is defined through the following example:

Suppose a report is due at 11:30am on Wednesday, if submitted anytime prior to 11:30am Wednesday full credit is given for what the student earns, so an 80/100 remains 80/100. If submitted 2:00pm on Wednesday, it is late within the span of one day and therefore 10% is subtracted based on what the student earns, so an 80/100 becomes 70/100. If submitted at 9:12am on Thursday, it is late within the span of one day and therefore 10% will be subtracted based on what the student earns, so an 80/100 becomes 70/100. If submitted at 2pm on Monday, it is late within 3 working days and therefore 30% is subtracted based on what the student earns, so an 80/100 becomes 50/100. If submitted at 2pm on Wednesday the following week, it is late within the span of 5 days and therefore 50% will be subtracted based on what the student earns, so an 80/100 becomes 30/100.

Note that plagiarism checks are in place for lab reports, when an excessive amount of plagiarism is found, a grade of zero will be given for that lab report. Also, experience has shown that a scan or other image saved as a PDF is not readable for a plagiarism check. Accordingly, such files are also deemed unacceptable and given a grade of zero since they cannot be evaluated consistently with the rest. The exception is that the original data sheet may be scanned as part of the overall lab report.

Canvas allows for resubmissions, however we only grade the last submission uploaded prior to the due date. No resubmissions will be considered, even if uploaded to Canvas, past the due date, or once graded, whichever comes first. Prior to the due date, or any grading performed, students may resubmit to fix their work. Past experience shows that a resubmission uploaded after the due date will only lower the score previously given. This is due to the automatically computed late policy.

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<sup>4</sup>The five working days does not apply in the summer, where due to a shortened timeline, specific lab report due dates are variable and dealt with in each particular class.

Lastly, past experience has shown a few students will knowingly submit an entirely incorrect document in an attempt to circumvent the policy that the lack of a submission leads to a failure. The course coordinator is the only person responsible to determine if a report was submitted in good faith or not. A report that has been deemed submitted not in good faith will be marked as if it were never submitted.

**Canvas discussions for laboratory report questions and answers:** Students are expected to use canvas discussions to ask the instructional team questions related to laboratory reports. Chances are that another student has the same question, and so by using canvas discussions everyone has the benefit of the questions and answers.

When a student has a question, first search to see whether or not that question has been previously created and an answer has been provided. Feel free to reply to a post if there is no answer or the answer is not clear.

Please note that timing is important, do not wait for the last minute since members of the instructional team are not constantly monitoring the discussion posts. Members of the instructional team will check the discussions a few times per week to provide feedback and answer only during normal business hours.

Online forum discussions are expected to be meaningful and of an academic nature to satisfy the Regular and Substantive Interaction requirement by the Department of Education. Note that: (i) sharing answers to graded questions/activities/methods/etc. is not permitted; and (ii) postings that are unprofessional, disrespectful, or offensive will be deleted.

**Update for remote / converged learning due to the SARS-CoV-2 virus:** For the laboratory, the following items will help clarify what we are doing and what is expected of students for the laboratory portion of ME215. Some of the items below seem obvious, but they serve to clarify any conflict with the text in prior face-to-face versions of the syllabus or general lab instructions.

1. Table 3.6 and Section 6 provides the lab schedule and mode of delivery for the Fall 2020 semester. The overall plan is to hold all laboratory modules online, followed by an optional (but limited for safety) hands on experience in the laboratory.
2. Online attendance is required.
3. Pre-lab quizzes will not be given.
4. In an effort to most effectively replicate a standard in person full classroom laboratory experience, the instructional team has prepared documents that overviews the main content, which is supported by videos and synchronous demonstrations by technicians (when possible), and a synchronous summary and Q&A session during the assigned lab period.
5. Data will be disseminated to each group on the date the laboratory would have normally occurred via canvas, on the lab report upload page.

Further details about the planning related to the laboratory are provided in Section 4.

**Makeup labs:** For a makeup, the makeup lab needs to be reserved online, and the provided makeup form must be attached to the submitted lab report so proper attendance may be kept. The makeup reservation is a google form that is only available with your NJIT UCID. The link may be found on Canvas, and it asks for details about what was missed and when you intend to make it up. After submission, your reservation is saved to a spreadsheet and an email sent to the instructors.

Class	Activity	Mode of Delivery (host)
1	Introduction	Synchronous online (instructor)
2	Library	Synchronous online (instructor and librarian)
3	Microanalysis	Synchronous online (instructor)
4	CNC	Synchronous online (instructor and technician)
5	Measurement and tolerance	Synchronous online (instructor)
6	Surface texture	Synchronous online (instructor)
7	Metal cutting	Synchronous online (instructor and technician)
8	Heat treatment	Synchronous online (instructor)
9	Mechanical properties	Synchronous online (instructor)
10	Measurement and tolerance	In person (instructor)
11	Measurement and tolerance	In person (instructor)
12	Measurement and tolerance	In person (instructor)
13	Measurement and tolerance	In person (instructor)
14	Measurement and tolerance	In person (instructor)

Table 1: Schedule overview for laboratory in the Fall 2020 semester. Please see Section 6 for specific details.

The makeup form must be completed in full prior to the student leaving the makeup lab. A makeup lab report is due one week (again, specifically five working days) after the makeup lab is completed.

Here are a few example cases to ensure clarity of the policy, in cases 1 and 2 everything goes as scheduled, however in cases 3 - 5, a lab is missed.

1. A student goes to a lab on 10/1, and the lab is finished. The report is then due one week later at the start of lab on 10/8.
2. A student goes to a lab on 10/1, and it is part 1 of a two part experiment. The student returns on 10/8 and part 2 of the lab is finished. The report is then due one week later at the start of lab on 10/15.
3. A student misses a lab on 10/1. That student then goes to a makeup lab on 10/21 in a different section. The report is due one week later on 10/28 with the makeup form attached.
4. A student goes to lab on 10/1, and it is part 1 of a two part experiment. That student misses part 2 of a lab on 10/8. That student then goes to a makeup lab on 10/21 for part 2 in a different section. The report is due one week later on 10/28 with the makeup form attached.
5. A student misses lab on 10/1, and it is part 1 of a two part experiment. The student goes to part 2 of a lab on 10/8 as scheduled. That student then goes to a makeup lab on 10/21 for part 1 with a different section. The report is due one week later on 10/28 with the makeup form attached.

Makeup labs can be attended throughout the semester, as the previous examples showed. Typically a student needs to refer to the lab schedule and find another section that will perform that laboratory at a time in the future. However, if the last laboratory was missed, or no other time exists, then there is no other section to attend. Accordingly, there will be two days set aside at the end of the semester for makeup labs, with a set of labs running in the day and that same set in the night. To ensure that we have adequate resources in place (instructors, TA's, supplies, etc.) we will only run a particular lab, at a particular time if it has been reserved. Details will be worked out after the second exam of the semester.

**Update for remote / converged learning due to the SARS-CoV-2 virus:** There are no makeup labs since students are not obligated to attend in person and may attend remotely online.

### 3.7 HW assignments

Homework is regularly assigned and the questions for the entire semester are posted at the end of this syllabus. Assignments will be collected via Canvas only, and a random sample of assignments will be graded at various times throughout the semester. The solutions to these assignments will not be posted, they will only be discussed in the class (either face-to-face or online). A late penalty of 10% per day will be enforced for late submissions.

### 3.8 Grading

Note that *late assignments, reports, etc., will not be accepted after the last day of class for the semester (i.e., the university wide last day of class, not the last day of lecture for your section)*. The weights shown in the table will be used in determination of the final course grade. Alongside are the letter grades and their corresponding description as written in the university undergraduate academic policy.

Exam 1:	20%	A	Superior
Exam 2:	20%	B+	Excellent
Final Exam:	25%	B	Very Good
Reports	} Laboratory:	C+	Good
Pre-lab quiz		C	Acceptable
HW/Library/Participation/etc.:	5%	D	Minimum
		F	Inadequate

In addition, an inability to meet 40% of the course objectives described previously will result in a grade of F regardless of performance. For example, any student that is unable to meet 4 out of the 9 listed performance criteria will be considered to have inadequate understanding of the course material — and therefore will earn a grade of F. Also, as mentioned previously an inability to submit or attend all labs will result in a failure regardless of performance. And note that external factors (such as level of effort, ability in other courses, time management, etc.) are typically not considered in the computation of grades.

In semesters where multiple sections of the course are running, for fairness and consistency, the final assigned grades will be determined among all sections at once. That implies that any curve will be computed among all sections, not just a single section. Any disagreement over grades must be brought to the attention of the instructor no later than the first two weeks of the following semester, grades will not be altered after that. Further, final grades are typically not discussed via email, an appointment should be made.

**Update for remote / converged learning due to the SARS-CoV-2 virus:** Please note that although the health crisis has altered typical instruction, this course still maintains the same expectations and rigor employed during normal times.

### 3.9 Academic integrity

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found [here](#).

Please note that it is the professional obligation and responsibility of faculty to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing, using any online software inappropriately, or other forms of dishonesty in academics will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.

### 3.10 Requirements

In order to ensure fairness and consistency among all sections of ME215, the following requirements and expectations are meant to ensure that all sections are equivalent, and everyone is treated equally and fair.

**Requirements for Instructors** Instructors will not fall behind the schedule posted on the syllabus for lecture, as well as the lab schedule (with the exception of officially cancelled days). Exam question booklets will be held for one year, while answer sheets are returned to the student immediately. It is the instructors responsibility to take and maintain attendance for all laboratory periods. Instructors are expected to remain in the laboratory for the entire laboratory period, *the instructor is the responsible person* for the people and equipment. If an instructor is sick or otherwise unavailable for a lab, then arrangements should be made to have someone cover since the schedule shouldn't be changed unless due to official school closures. When a student from section "A" is doing a makeup lab in section "B" that student will have a pre-lab quiz and makeup form. The instructor should place the completed pre-lab quiz in the mailbox of the professor for the student's regular section. This allows the instructor of the regular section to confirm the new report deadline to account for the makeup. The course coordinator will arrange for two laptops for use with all lab class periods with media services. All instructors (and TA's) should meet at the start of the semester to coordinate.

**Requirements for TA's** The TA's will input the due dates for lab reports on Canvas, including those for makeup labs. Have lab reports graded in a timely matter using the rubric. Do not override the prescribed late policy for reports described here previously. Obtain the laptops from media services before the lab period starts, and return them when the lab period is finished (before 9pm for night classes). The most senior TA and the course coordinator will determine the specific lab schedule every semester. For new TA's, they should attend to prior classes for practical experience. All TA's should meet with the instructors at the start of the semester to coordinate.

**Requirements for students** Prior to the start of the lab class period, print a hard copy of the lab manual, read it, and bring it to the lab class period. Ensure that you have taken the pre-lab quiz for attendance. The student is responsible to attend all labs, and complete all reports since they are mandatory. As soon as possible after missing a lab, it is the responsibility of the student to fill out the online makeup lab reservation form to arrange for a makeup lab, and also to bring a hardcopy of the makeup form for signatures, so that proper credit can be received. It is the

responsibility of the student to inform the dean of students of any missed exam or other mandatory materials. Employment is not considered a valid reason for missing an exam, class, lab, or any portion of the class. If you feel you are not going to pass this course, please reach out to your instructor with adequate time before the drop date.

### Update for remote / converged learning due to the SARS-CoV-2 virus:

- Instructors – There are no more exam booklets for the online exams. There is no need for pre-lab quizzes and their record keeping for makeup labs. There is no need to arrange for laptops, but perhaps an OWL camera.
- TA's – No need to obtain laptops anymore. The specific lab schedule is already set.
- Students – Verify that you are able to take the online exams with ample time prior to the exam. Now that we have moved to mostly remote laboratory, students are not to come in person for routine laboratory. If you wish to partake in a hands on experience in the laboratory, we will have a sign up form available on canvas (with a deadline).

## 4 Fall 2020 Laboratory Experience and Rationale<sup>5</sup>

To support transparency, in planning for the Fall 2020 laboratory portion of ME215 the instructional team attempted to make the laboratory experience as hands-on as possible for those students wishing to attend in person laboratory. However, early in planning, the instructional team ran into multiple roadblocks that are not easily overcome safely.

In making the plans for the laboratory portion of the class, we have made use of CDC guidance for 6 feet social distancing and for disinfecting a facility, which may be found online [here](#). The most relevant portions of the CDC guidance for facility disinfection are summarized here:

- Disinfect
  - Recommend use of EPA-registered household disinfectant.
  - Follow the instructions on the label to ensure safe and effective use of the product.
  - Many products recommend:
    - \* Keeping surface wet for a period of time (see product label).<sup>6</sup>
    - \* Precautions such as wearing gloves and making sure you have good ventilation during use of the product.
- Electronics (such as tablets, touch screens, keyboards, remote controls, and ATM machines)
  - Consider putting a wipeable cover on electronics.
  - Follow manufacturers instruction for cleaning and disinfecting. If no guidance, use alcohol-based wipes or sprays containing at least 70% alcohol. Dry surface thoroughly.
- Soft surfaces (such as carpeted floor, rugs, and drapes)

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<sup>5</sup>This entire section is devoted to specific details for remote / converged learning due to the SARS-CoV-2 virus, but is not all red.

<sup>6</sup>For reference, Clorox Performance Bleach indicates 5 minutes wet, followed by a rinse and air drying, and Kirkland Signature (Costco) Disinfecting Wipes indicate 15 minutes wet, followed by air drying. At the time of writing this syllabus, the specific disinfectant to be provided in the classroom is unknown.

- Clean the surface using soap and water or with cleaners appropriate for use on these surfaces.
- Launder items (if possible) according to the manufacturers instructions. Use the warmest appropriate water setting and dry items completely.

This plan is also made upon the assumption that the individual faculty and students will be responsible for disinfecting the laboratory equipment/tools/components that would have been in use that lab class period.

The main roadblocks are that each section is at least 50% overloaded; and we only have one machine/tool/component that requires a large amount of sharing or being in close proximity for extended times for the hands-on experience. These two couple together so that the time to wait for disinfection between students would limit our ability to offer an in-person experience to many of the students. Accordingly, the schedule provided in Table 3.6 and Section 6 will be followed where all laboratory modules are performed online, followed by an optional hands on experience dealing with measurements.

## 4.1 Standard set of laboratory sessions

Here the standard set of laboratory sessions are listed along with the plan to recreate the experience remotely and the justification.

### 4.1.1 Introductory session

**Plan:** All students will participate remotely online, with the instructional team delivering the introduction to the laboratory synchronously online.

**Justification:** There is nothing hands-on this session.

### 4.1.2 Library research session

**Plan:** All students will participate remotely online, and the librarian will deliver the usual lecture online.

**Justification:** The room typically used in the library is no longer available for student use. And this is essentially a lecture carried out by the librarian.

### 4.1.3 Microanalysis

**Plan:** All students will participate remotely online. The instructional team has prepared a document that overviews the main content, which is supported by videos, and a synchronous summary and Q&A session during the assigned lab period. This content is built upon what was learned and improved on from Spring and Summer 2020 semesters.

**Justification:** The classroom has only one digital microscope (without a wipeable cover), and only one set of samples that are appropriate for using. The equipment is housed in a room the size of a closet. Equipment coupled with disinfection time considerations would limit the hands-on experience to one student per class period. Further, a great amount of effort goes into proper sample preparation, including chemical etching, and the application of disinfectant to the samples

would undoubtedly obfuscate the main micro-structural features that lie at the heart of the learning objective.

#### 4.1.4 CNC week 1

**Plan:** All students will participate remotely online. The instructional team has prepared a document that overviews the main content, which is supported by videos and synchronous demonstrations by technicians (when possible), and a synchronous summary and Q&A session during the assigned lab period. This content is built upon what was learned and improved on from Spring and Summer 2020 semesters.

**Justification:** There is nothing hands on for this particular laboratory session.

#### 4.1.5 CNC week 2

**Plan:** All students will participate remotely online. The instructional team has prepared a document that overviews the main content, which is supported by videos and synchronous demonstrations by technicians (when possible), and a synchronous summary and Q&A session during the assigned lab period. This content is built upon what was learned and improved on from Spring and Summer 2020 semesters.

**Justification:** The majority of this laboratory session is not hands-on, it is based mostly on the underlying code required to run a CNC machine along with a demo, students do not ever touch the CNC machine itself.

The classroom has only one CNC machine (without a wipeable cover) with limited space capable of viewing due to safety shrouds. Additionally only one or two students would be able to view the CNC machine demonstration while maintaining a 6 foot distance. The classroom has multiple CNC computer stations (without wipeable covers) that can accommodate a maximum of 3 students per class period. However all of these are directly related to the learning objective, with the CNC computer simulators serving a minimal role, but the only hands-on part of the experience.

Since we can have the technician do the demo synchronously online (when possible) and take questions live synchronously online, there is no loss in learning objective by having students remotely online.

#### 4.1.6 Measurement and tolerance week 1

**Plan:** All students will participate remotely online. The instructional team has prepared a document that overviews the main content, which is supported by videos, and a synchronous summary and Q&A session during the assigned lab period. This content is built upon what was learned and improved on from Spring and Summer 2020 semesters.

**Justification:** While the classroom has an adequate number of measuring instruments (calipers, etc.) for a reduced student capacity, however students share the parts that are being measured. Disinfection time considerations limits the number of students per class period that can participate in any hands-on experience.

#### 4.1.7 Measurement and tolerance week 2

**Plan:** All students will participate remotely online. The instructional team has prepared a document that overviews the main content, which is supported by videos, and a synchronous summary and Q&A session during the assigned lab period. This content is built upon what was learned and improved on from Spring and Summer 2020 semesters.

**Justification:** The classroom has only one optical comparator and granite block / dial indicator that works. Equipment coupled with disinfection time considerations would limit the hands-on experience to two students per class period, however they would be doing different portions of this particular lab not overlapping.

#### 4.1.8 Surface topology

**Plan:** All students will participate remotely online. The instructional team has prepared a document that overviews the main content, which is supported by videos, and a synchronous summary and Q&A session during the assigned lab period. This content is built upon what was learned and improved on from Spring and Summer 2020 semesters.

**Justification:** The classroom has only one perthomoeter (without a wipeable cover), one surfometer (without a wipeable cover), and one hand feeler gauge. The perthometer and surfometer are housed in a room the size of a closet, while the hand feeler gauge is a tool where you use your hand to compare based on touch. Further, we have limited samples where surface roughness measurements are taken, and they are normally shared among students. Equipment and sample considerations coupled with disinfection time would limit the hands-on experience to one student per class period.

#### 4.1.9 Metal cutting

**Plan:** All students will participate remotely online. The instructional team has prepared a document that overviews the main content, which is supported by videos and synchronous demonstrations by technicians (when possible), and a synchronous summary and Q&A session during the assigned lab period. This content is built upon what was learned and improved on from Spring and Summer 2020 semesters.

**Justification:** While the classroom has an adequate number of measuring instruments (calipers, etc.) for a reduced student capacity, students share the cutting tools that are being measured. Since we can have the technician do the demo synchronously online (when possible) and take questions live synchronously online, there is no loss in learning objective by having students remotely online.

#### 4.1.10 Heat treatment week 1

**Plan:** All students will participate remotely online. The instructional team has prepared a document that overviews the main content, which is supported by videos, and a synchronous summary and Q&A session during the assigned lab period. This content is built upon what was learned and improved on from Spring and Summer 2020 semesters.

**Justification:** We only have one hardness tester (without a wipeable cover) and two sets of safety gear. Equipment considerations would limit the hands-on experience to one student per class period. And since the safety gear is a leather smock, leather jacket, leather shoe protectors, safety glasses, a face shield, and heat resistant gloves, we do not have the appropriate cleaning equipment for the majority of the safety gear which is a soft surface.

#### 4.1.11 Heat treatment week 2

**Plan:** All students will participate remotely online. The instructional team has prepared a document that overviews the main content, which is supported by videos, and a synchronous summary and Q&A session during the assigned lab period. This content is built upon what was learned and improved on from Spring and Summer 2020 semesters.

**Justification:** We only have one hardness tester (without a wipeable cover) and two sets of safety gear. Equipment considerations would limit the hands-on experience to one student per class period. And since the safety gear is a leather smock, leather jacket, leather shoe protectors, safety glasses, a face shield, and heat resistant gloves, we do not have the appropriate cleaning equipment for the majority of the safety gear which is a soft surface.

#### 4.1.12 Tensile testing (honors lab)

**Plan:** All students will participate remotely online. The instructional team has prepared a document that overviews the main content, which is supported by videos, and a synchronous summary and Q&A session during the assigned lab period. This content is built upon what was learned and improved on from Spring and Summer 2020 semesters.

**Justification:** The lab only has one machine with multiple components and some fragile and not liquid safe that require physical contact (no wipeable covers are present, and some components cannot be enclosed with a cover due to their operation). Equipment coupled with disinfection time considerations would limit the hands-on experience to one student per class period.

## 4.2 Optional hands on experience

For the optional hands on experience, based on the rationale above, the instructional team has determined that the measurement laboratory module is the most suitable — it allows the most students into the classroom, and also is the safest in terms of mitigating possible virus exposure and extended times in close proximity to others.

**How to sign up:** A google form will be linked in canvas for those that wish to sign up. A deadline will be imposed so that equipment, cleaning supplies, PPE, and other accommodations may be made beforehand.

**Limitations:** The hands on experience is limited in the number of students per scheduled class time that may participate. Since each section has at least 30 students, and we only have 5 weeks to conduct this hands on experience, it is anticipated that not everyone will have the opportunity. Accordingly, if the situation arises where more students wish to participate than we have space, we will follow the following:

1. If slots are open in another section, the instructional team will ask if a student can move to an open time in that other section.
2. If there is still more demand than available times, a lottery will be used to randomly pick those students that can take part.

**What to expect:** Students that come to the laboratory in person should expect to have a hands on learning experience using various measurement tools. They include vernier calipers, gauge blocks, micrometers, and more. Specific exercises will involve simple linear dimensional measurements, diameters, inside and outside tapers, and more.

## 5 Tentative Lecture Schedule<sup>7</sup>

Section schedules are color coded as follows: 001 & HM1; 003; 009 & HM3; 011; 101; 103; and labelled with the “lecture number” in the calendar below. For asynchronous lectures, the day posted is the day that the lecture slides become available. Note that the schedule may be changed due to unforeseen circumstances such as weather closings, public health emergencies, etc.

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
8/31/20	9/1/20 101-1	9/2/20 103-1	9/3/20	9/4/20
9/7/20 Labor Day	9/8/20 001-1 003-1 009-1 011-1 Mon. Classes Meet	9/9/20 103-2	9/10/20	9/11/20
9/14/20 001-2 003-2 009-2 011-2	9/15/20 101-2	9/16/20 103-3	9/17/20	9/18/20
9/21/20 001-3 003-3 009-3 011-3	9/22/20 101-3	9/23/20 103-4	9/24/20	9/25/20
9/28/20 001-4 003-4 009-4 011-4	9/29/20 101-4	9/30/20 103-5	10/1/20	10/2/20
10/5/20 Common Exam 1	10/6/20	10/7/20	10/8/20	10/9/20
10/12/20 001-5 003-5 009-5 011-5	10/13/20 101-5	10/14/20 103-6	10/15/20	10/16/20
10/19/20 001-6 003-6 009-6 011-6	10/20/20 101-6	10/21/20 103-7	10/22/20	10/23/20
10/26/20 001-7 003-7 009-7 011-7	10/27/20 101-7	10/28/20 103-8	10/29/20	10/30/20
11/2/20 Common Exam 2	11/3/20	11/4/20	11/5/20	11/6/20
11/9/20 001-8 003-8 009-8 011-8	11/10/20 101-8	11/11/20 103-9	11/12/20	11/13/20
11/16/20 001-9 003-9 009-9 011-9	11/17/20 101-9	11/18/20 103-10	11/19/20	11/20/20
11/23/20 001-10 003-10 009-10 011-10	11/24/20 101-10	11/25/20 Fri. Classes Meet	11/26/20 Thanksgiving	11/27/20
11/30/20 001-11 003-11 009-11 011-11	12/1/20 101-11	12/2/20 103-11	12/3/20	12/4/20
12/7/20 001-12 003-12 009-12 011-12	12/8/20 101-12	12/9/20 103-12	12/10/20	12/11/20 Reading Day

<sup>7</sup>Note that this section does not apply to summer courses, where details are handled in each class.

## 6 Tentative Lab Schedule<sup>8</sup>

Section schedules are color coded as follows: 001 & HM1; 003; 009 & HM3; 011; 101; 103; and labelled with the planned activity in the calendar below. Note that the schedule may be changed due to unforeseen circumstances such as weather closings, public health emergencies, etc.

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
8/31/20	9/1/20 003 / 011 / 101 - Intro	9/2/20 103 - Intro	9/3/20 009&HM3-Intro	9/4/20 001&HM1-Intro
9/7/20 Labor Day	9/8/20 Mon. Classes Meet	9/9/20 103 - Library	9/10/20 009&HM3 - Library	9/11/20 001&HM1 - Library
9/14/20	9/15/20 003 / 011 / 101 - Library	9/16/20 103 - Microanalysis	9/17/20 009&HM3 - Microanalysis	9/18/20 001&HM1 - Microanalysis
9/21/20	9/22/20 003 / 011 / 101 - Microanalysis	9/23/20 103 - CNC	9/24/20 009&HM3 - CNC	9/25/20 001&HM1 - CNC
9/28/20	9/29/20 003 / 011 / 101 - CNC	9/30/20 103 - Measurement	10/1/20 009&HM3 - Measurement	10/2/20 001&HM1 - Measurement
10/5/20	10/6/20 003 / 011 / 101 - Measurement	10/7/20 103 - Surface Texture	10/8/20 009&HM3 - Surface Texture	10/9/20 001&HM1 - Surface Texture
10/12/20	10/13/20 003 / 011 / 101 - Surface Texture	10/14/20 103 - Metal Cutting	10/15/20 009&HM3 - Metal Cutting	10/16/20 001&HM1 - Metal Cutting
10/19/20	10/20/20 003 / 011 / 101 - Metal Cutting	10/21/20 103 - Heat Treatment	10/22/20 009&HM3 - Heat Treatment	10/23/20 001&HM1-Heat Treatment
10/26/20	10/27/20 003 / 011 / 101 - Heat Treatment	10/28/20	10/29/20 HM3 - Mech. Props.	10/30/20 HM1 - Mech. Props.
11/2/20	11/3/20	11/4/20 103 - Hands On 1	11/5/20 009&HM3 - Hands On 1	11/6/20 001&HM1 - Hands On 1
11/9/20	11/10/20 003 / 011 / 101 - Hands On 1	11/11/20 103 - Hands On 2	11/12/20 009&HM3 - Hands On 2	11/13/20 001&HM1 - Hands On 2
11/16/20	11/17/20 003 / 011 / 101 - Hands On 2	11/18/20 103 - Hands On 3	11/19/20 009&HM3 - Hands On 3	11/20/20 001&HM1 - Hands On 3
11/23/20	11/24/20 003 / 011 / 101 - Hands On 3	11/25/20 001&HM1 - Hands On 4 Fri. Classes Meet	11/26/20 Thanksgiving	11/27/20
11/30/20	12/1/20 003 / 011 / 101 - Hands On 4	12/2/20 103 - Hands On 4	12/3/20 009&HM3 - Hands On 4	12/4/20 001&HM1 - Hands On 5
12/7/20	12/8/20 003 / 011 / 101 - Hands On 5	12/9/20 103 - Hands On 5	12/10/20 009&HM3 - Hands On 5	12/11/20 Reading Day

<sup>8</sup>This entire section is devoted to specific details for remote / converged learning due to the SARS-CoV-2 virus, but is not all red.

## 7 Lecture Topics and Assignments

Lecture	Topic	Pages	HW; Review Questions
1	Introduction, and manufacturing systems design	1-22	Ch.1: 1, 3, 6, 17, 26, 31, 32
2	Nature of materials	45-56	Ch.3: 1, 2, 6, 16, 17, 21, 22, 23, 29, 30, 34, 37
3	Properties of materials. Fundamentals of metal alloys. Equilibrium diagrams. Iron - Iron carbide equilibrium diagram, steels and cast Irons.	23-44, 57-66	Ch.2: 3, 6, 10, 11, 15, 16, 21, 24, 42, 43. Ch.4: 2, 4, 12, 13-18, 22, 28-30, 32-35, 37, 39
4	Heat treatment of metals	67-86	Ch.5: 1, 5-7, 11, 12, 23, 25, 32, 59
5	Ferrous metals and alloys, cast irons and steels, and non-ferrous alloys. Non-metallic materials. Materials selection.	87-105, 106-124, 125-152, 153-162	Ch.6: 2, 11, 17, 19, 23, 47, 54; Ch.7: 4, 5, 7; Ch.8: 3, 5, 46; Ch.9: 4
6	Fundamentals of metal forming, bulk forming, hot and cold working, and sheet forming	292-303, 304-330, 331-358	Ch.17: 3, 24, 37, 47; Ch.18: 5, 48, Ch.19: 1, 20, 35, 46
7	Casting, powder metallurgy, joining process, and their influence on design aspects.	221-235, 236-259, 260-274, 275-291, 680-689, 690-711, 712-725, 726-745	Ch.13: 2, 8, 10; Ch.14: 1, 50; Ch.15: 1, 3, 4, 28; Ch.16: 1, 2, 5, 11, 15; Ch.35: 3, 7; Ch.36: 2, 9, 11; Ch.37: 7; Ch.38: 6, 14, 18, 33, 40
8	Measurement and inspection.	163-185, 186-196	Ch.10: 1, 10, 11, 21, 23; Ch.11: 5, 8, 9, 10
9	Fundamentals of machining and tool geometry.	381-404, 405-427	Ch.21: 3, 4, 6, 15; Ch.22: 1, 6, 8, 13, 17
10	Turning, boring, and drilling	428-446, 462-481	Ch.23: 2, 4, 8, 21; Ch.25: 8, 21, 23;
11	Milling, sawing, broaching, other machining. CNC.	447-461, 502-522, 482-501	Ch.24: 1, 12; Ch.27: 34; Ch.26: 1, 23
12	Additive processes	637-655	Ch.33: 2, 10, 12, 13, 70

## 8 Exam coverage

- Exam 1 covers all material covered in lectures 1 through 3.
- Exam 2 covers all material covered in lectures 3 through 7. (There is indeed some overlap.)
- The final exam covers all lecture and lab material.