ME 495 – LABORATORY II
Winter 2017

Instructors:

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Prerequisite: ME 395- Laboratory I

Lectures: 80-minute lecture on Monday and Friday, 1:40 – 3:00 pm in 1013 DOW.

Laboratory: Three hours of laboratory each week. Students will usually be divided into groups of four for most labs. The location of the laboratories will vary and be announced in class.

Office Hours: Prof. Reddy, 1634, GG Brown Addition, Tu 3:00 – 5:00 pm or by appointment
Prof. Meyhofer, 1636, GG Brown Addition M 3:00 – 5:00 pm or by appointment
Dr. Erik Hildinger, 323 Gorguze Family Laboratory, TBA
Dr. Eric Kumpf, 311 Gorguze Family Laboratory, TBA

Web Page: The course web-page is available on https://umich.instructure.com/courses/121984

Course Objectives:

1. Analysis of complex engineering systems.
2. Practical illustration of concepts taught in the core courses.
3. Proposal and execution of an experimental and analytical program.
4. Professional presentation and scientific documentation of procedures and findings, including formal and informal reports, formal and *impromptu* oral presentations, and poster displays.
5. Effective teamwork and teamwork management.

The laboratories in ME495 are longer and more open-ended than those in ME395. Consequently, students will be asked to creatively address problems that may have more than one "correct" solution.

Laboratory Topics

Laboratory 1 – Integrated Circuit Cooling
Laboratory 2 – Flexible Shaft Dynamics
Laboratory 3 – Nanoscale Metrology and Noise Analysis

ME 495- WEEKLY SCHEDULE

Changes, if any, will be announced during lectures and updated on the web.

Week 0 (No Lab)
Friday, 1/06/17 Course Introduction; Drop-Add Sections

Week 1 (Lab in GGBL 2541)
Monday, 1/09/17 Lab 1: "Integrated Circuit Cooling"
Friday, 1/13/17 Lab 1: "Integrated Circuit Cooling"

Week 2 (Lab in GGBL 2541)
Monday, 1/16/17 Lab 1: **MLK Day (No Lecture)**
Friday, 1/20/15 Lab 1: "Integrated Circuit Cooling"

Week 3 (Lab in GGBL 2541)
Monday, 1/23/17 Lab1: "Integrated Circuit Cooling"
Friday, 1/27/17 Lab 1: "Integrated Circuit Cooling"

Week 4 (Lab in GGBL 2541)
Monday, 1/30/17 Lab 2: "Flexible Shaft Dynamics"
DUE: LAB 1 Report (To the GSI within 10 minutes into the lab section)
Friday, 2/03/17 Lab 2: "Flexible Shaft Dynamics"

Week 5 (Lab in GGBL 2541)
Monday, 2/06/17 Lab 2: "Flexible Shaft Dynamics"
Friday, 2/10/17 Lab 2: "Flexible Shaft Dynamics"

Week 6 (Lab in GGBL 2541)
Monday, 2/13/17 "Flexible Shaft Dynamics"
Friday, 2/17/17 Lab 2: **Return Graded Lab 1**

Week 7 No Labs, Poster presentations during lab session (location to be announced)

DUE: LAB 2 Handout (To be handed emailed to the GSI before start of poster session)
DUE: LAB 2 poster presentation. Will be held during lab session.

Week 8 (Lab in GGBL 2541) **Break (No Lectures)**
Monday, 2/27/17 Lab 3: **No Lectures**
Friday, 3/3/17 Lab 3: **No Lectures**

Week 9 (Lab in GGBL 2541)
Monday, 3/6/17 Lab 3, "Nanoscale Metrology and Noise Analysis"
Friday, 3/10/17 Lab 3, "Nanoscale Metrology and Noise Analysis"
Discuss lab 2 poster session, Return graded lab 2 handout

Week 10 (Lab in GGBL 2541)

Monday, 3/13/17 Lab 3, "Nanoscale Metrology and Noise Analysis"
Friday, 3/17/17 Lab 3, "Nanoscale Metrology and Noise Analysis"

Week 11 (Lab in GGBL 2541)

Monday, 3/20/17 Lab 3, "Nanoscale Metrology and Noise Analysis"
DUE: LAB 3 oral presentations in lab section with faculty attending
Friday, 3/24/17 Lab 3, "Nanoscale Metrology and Noise Analysis"

Week 12 (Lab in GGBL 2541)

Monday, 3/27/17 Lab 3 "Nanoscale Metrology and Noise Analysis"
Friday, 3/31/17 Lab 3, "Nanoscale Metrology and Noise Analysis"

Week 13 (Lab in GGBL 2541)

Monday, 4/03/17 Lab 3 "Nanoscale Metrology and Noise Analysis"
Friday, 4/07/17 Lab 3 "Nanoscale Metrology and Noise Analysis"

Week 14 (Lab in GGBL 2541)

Monday, 4/10/17 Final Lecture
Friday, 4/14/17 No Lecture
DUE: LAB 3 (To the GSI within 10 minutes into the lab section during Week 14)

COMPLETION, GRADING, AND REVISION OF ASSIGNED WORK

Your final grade is derived from three components:

- **Team Grades on the three laboratories, 90%**
  - ¾ ~ Technical Content
  - ¼ ~ Communication
- **Participation and Safety, 10%**

Grading: The final grade will be based on the following percentages:

LAB	DELIVERABLE	LENGTH	EFFORT TYPE	% OF TOTAL
1	Memo Report	6 – 7 pp	Group	**20%**
2	Poster Display Handout	 3 pp	Group	**25% (15% Report + 10% Poster)**
3	Oral presentation Journal Style Report	10 min plus Q&A 10 -12 pp	Group Group	**10%** **35%**

1. Your group will generate technical communication deliverables based on experimental work and data analysis performed in lab, and the real world *scenarios* created for the course. Each *scenario* will include brief background information for your work assignment.

2. The deliverables should be prepared to the following guidelines:

- All text must be word-processed.

- Follow the page lengths specified for the assignments. The page lengths apply only to the text and graphics in the main body of the document. Front matter such as title pages and back matter such as attachments do not count toward the page lengths. Meeting minimum page lengths ensures you get adequate practice, while meeting maximum page lengths requires you to make decisions regarding what is important enough for your target audience to be included in the main body of the document.

- The contributions of each team member (author contributions) to the project must be defined on the front page.

- All graphics must be professional quality and computer generated. All text inserted in the graphics must be clearly legible. Unless otherwise specified, no hand-drawn graphics are acceptable.

- Important graphics and associated figure legends should be integrated in the text of the document body. Only supporting graphics are to be included in the attachments.

3. All products must be submitted on their due dates, at the beginning of the class meeting. Late work will receive a full-grade penalty for each day late.

4. Each group member must fill out a confidential team evaluation form at the conclusion of each of the laboratories. This evaluation also serves to document the role of each team member during the project.

Continuous Improvement. The organization, form, and materials for this course are under constant revision, based on input from students, GSIs, and faculty. Constructive criticism and suggestions for improvement of the course as a whole are always welcome. Please direct any such commentary to one of the faculty.

SAFETY

Phone Numbers: **EMERGENCY: 911**
UM Department of Public Safety: 763-1131
ME Facilities Office: 764-3547 or 647-9775
Phones are located in the hallway east of G019AL.

As in many engineering environments, students in the ME 495 laboratory will be working with equipment, materials and power sources which, if used improperly, can present a serious **safety hazard**. While the laboratory equipment and procedures have been designed with your safety in mind, negligent use of the equipment can result in unsafe situations and possibly **serious injury**. We remind you to be especially aware of your own personal safety and that of your lab group as you participate in the experiments.

Potential Safety Hazards include, but are not limited to, the following:

High voltage electrical lines	Pressurized air and water lines
Powered mechanical equipment	Heated surfaces and high temperatures
Liquid Mercury	Loud noises
Laser light sources	Heavy, suspended platforms

None of the experiments will present a serious risk if proper attention is paid to the written laboratory instructions along with the guidance of the graduate student instructors (GSIs). If, at any time, a situation develops which you deem to be unsafe, do not proceed with the laboratory and immediately report it to your lab section supervisor (GSI, staff, technician).

Furthermore, students will be expected to behave in a responsible manner while participating in the laboratory. The lab section supervisor (GSI, staff, technician) will be responsible for maintaining a **safe laboratory environment**. If at any time the section supervisor feels that a student is disregarding this warning and willfully acting in an **unsafe** manner, the section supervisor has been instructed to **expel** the student from the lab and report this action to the course instructors.

Safety glasses and proper clothing must be worn at all times while in the laboratory. Safety glasses must be provided by the student (ordinary eye glasses seldom satisfy safety requirements). Open-toed shoes, high-heeled shoes, dangling hair, ties, long necklaces, and scarves should not be worn. Food and beverages are not allowed in the laboratory. Wash your hands at the completion of the laboratory.

As practicing engineers you will be often working around potentially hazardous machinery. Always **think** about the **consequences** of your actions **before proceeding**, and if you are unsure, do not continue until your questions or concerns are dealt with.

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I have read the above safety information, attended an ME 495 safety lecture, and agree to abide by the safety rules of ME 495:

_____ _____
Printed Name Signature

_____ _____
Date Laboratory Section

RIGHTS AND RESPONSIBILITIES OF TEAM MEMBERS

As an engineer, you will usually be required to work with others in a team. In this laboratory course, the majority of your grade will result from team efforts. Teams are successful when team members organize themselves, divide up the work fairly, and maintain clear lines of communication. As a member of a lab team in ME 495, you have certain rights and responsibilities:

Each team member has the **right** to participate equally in the team effort. No team member can be excluded from participating. A team member who feels he or she is being excluded by the rest of the group should contact the instructor immediately. For the various lab reports, an individual has the **right** to turn-in his or her own assignment if the team members, section supervisor, course instructors are notified more than 5 days before the report is due.

Each team member has the **responsibility** to participate equally in the overall team efforts, attend all lectures, lab sections and help gather and process experimental data. Each team member has the **right** to access all data gathered by the team. All laboratory reports and presentations are team efforts, however, any member of a team has the **right** to submit his or her own report if the course instructors are contacted at least five days before an assignment is due. Further, a team has the **right** to turn-in a lab report not bearing the name of a non-participating team member, if the non-participating team member, section supervisor, and course instructors are notified at least 5 days before the report is due. In these cases, a memorandum should be submitted with the report justifying why these unusual steps were taken.

If a team is not functioning well, the team members have the **responsibility** to meet with the instructor to discuss the problems.

Students will be asked to evaluate both their own performance and that of the other members on the team. All individuals have the **responsibility** to fairly and honestly evaluate the performance of their team members using the peer evaluation sheets. These confidential evaluations will be used to help determine the participation level of each team member.

HONOR CODE AND LABORATORY REPORT WRITING

The following is excerpted from the College of Engineering Honor Code:

> "The principles of the Honor Code apply to homework and laboratory assignments as well as to examinations. The instructor may prohibit collaboration among students on such assignments. The instructor is to make clear how much, if any, collaboration is permissible. The instructor may also require that the students write and sign the Honor Pledge on the homework and lab reports."
>
> "A deliberate attempt to present as one's own work any material copied from another student, done jointly with another student, or copied from an unacknowledged source is a violation of the Honor Code."
>
> "It is a violation of the Honor Code for students to submit, as their own, work which is not the result of their own labor and thoughts. Work which includes material derived in any way from the efforts of another author, either by direct quotation or paraphrasing, should be fully and properly documented. The basic principle is to tell the reader enough to locate the quoted material in the original source."

With this in mind, it is NOT permissible for ME 495 students to do the following:

- Consult previously prepared ME 495 reports.
- Use previously prepared ME 495 reports as "templates" for the currently required lab report (e.g. "filling in the blanks and changing the dates...")
- Plagiarize portions of old ME 495 reports.
- Falsify team member evaluation forms.

It is permissible to consult with current or former ME 495 students on technical issues. All such consultation must be acknowledged in the report. However, such consultation is not encouraged because it often leads to inaccuracies. Technical consultation with GSIs and with the faculty (on any lab) is strongly encouraged and need not be referenced in your reports.

Suspected honor code violations in ME 495 will be forwarded to the Engineering Honor Council for adjudication.

ME 495: Team Member Evaluation Form for Laboratory __

Section Number _____ Date _____

Your Name _____

Evaluate everyone in the group, including you, using this form. Staple the evaluation closed and turn it in to your GSI when the written report for a lab is due. DO NOT SHOW YOUR COMPLETED FORM TO OTHER STUDENTS. This information will be used to determine part of your grades. All the answers you provide must be accurate.

Names:	_____	_____	_____	_____
	_____	_____	_____	_____
1. % contribution to the laboratory effort	_____%	_____%	_____%	_____%
2. % contribution in data reduction	_____%	_____%	_____%	_____%
3. % contribution in writing the report	_____%	_____%	_____%	_____%
4. This person followed best teamwork practices. (circle one)	strongly agree agree neutral disagree strongly disagree	strongly agree agree neutral disagree strongly disagree	strongly agree agree neutral disagree strongly disagree	strongly agree agree neutral disagree strongly disagree

5. Write a brief but specific justification (with examples) for each case in which you consistently rated someone below 20%, above 50%, or worse than neutral.

6. This group was (circle one) very somewhat not very effective. Explain.

ME 495 TEAMWORK GUIDELINES

The modern global economic system requires teams to respond to rapid technological change and ever increasing demands on product price and performance. Team work is equally important in engineering and scientific research in academic institutions. Successful organizations have responded to these challenges, increased research productivity and decreased product development times by using flatter, more-flexible organizational structures that better service their entire value chain (i.e. less hierarchy). In this ever-evolving research and business environment, the cross-disciplinary team has become the primary productive/administrative unit, and technical communication of ideas, knowledge, and information has become a, if not the major, limiting step. Hence, the development of teamwork and technical communication skills are an integral part of the undergraduate training of mechanical engineers.

Effective teams are more efficient because meeting time is used wisely and the workload is shared evenly. Effective teams are also more likely to produce higher-quality, more technically accurate reports because the entire team's intellectual resources are fully exploited.

Team Formation and Development. Effective teams do not form instantly, but must develop to function well. In addition, while no individual will truly be an ideal team member, every person who strives to be a good team member will make significant contributions to the goals and success of the team. In this class, the main product of your teamwork should be technically excellent and well-written reports which can be only accomplished by careful planning of experiments, analysis of data and dividing the load of writing the reports. This can only be achieved by developing an efficient team.

The five stages of team development are frequently referred to as *forming, storming, norming, performing,* and *adjourning*. In ME 495, you will want your team to get to the performing stage as quickly as possible.

> ***Forming***. This occurs when the team first comes together. At this stage almost everyone is cautious and polite, but they are wearing their thickest social armor. The team can form efficiently if team members exchange contact information (e-mail addresses or phone numbers), state their individual interest level in the course, and share their personal goals for the team. Even if everyone disagrees, at least this information is out in the open and unpleasant future surprises can be avoided.
>
> ***Storming***. This is the least comfortable part of team development because everyone is still pursing goals based only on their own point of view, and the rules for conflict resolution have not been settled on. The development of many ME 495 teams gets frozen here and the quality of the resulting lab work and final report suffers. Picking well-understood team member roles is one way to get past the storming stage because team member roles help to align individual goals with team goals. ME 495 students are strongly encouraged to try all possible team member roles over the course of the team.
>
> ***Norming***. At this point, team members are starting to be useful to each other and genuine trust between individuals is developing. Completing tasks ahead of schedule and sharing the results with your team members (perhaps by e-mail) is the best way to reach this team development stage. Encouraging those who are behind in their work or who are less interested in the class is also suggested.

Performing. This is where team development really needs to be by the middle or end of the second meeting. Everyone is working together toward a common goal, no one is unfairly burdened, and everyone is intellectually challenged. Trust and respect between individuals has been established.

Adjourning. This occurs when the team has completed its task. If all the stages of team development have gone well, there will be strong positive feelings for the team experience at this point, and the team members will want to thank each other for the experience of working together.

In addition to these five team development stages, there are two sets of behaviors that teams need to adopt: task-oriented and maintenance-oriented behaviors. Task-oriented behaviors are responses to address and complete the work associated with accomplishing the team's goals. Learning and executing these behaviors is the emphasis of the teamwork training in ME 495. Maintenance-oriented behaviors are associated with the emotional and personal needs of the team members. These ensure a good working relationship within the team. Although these are given less emphasis in ME 495, maintenance-oriented behaviors may be equally important to team success. A third class of behaviors, *self-oriented behaviors*, is destructive to the team and should be avoided.

Best Practices for Team Meetings. Effective team meetings greatly facilitate team development and the likelihood of fostering task-oriented and maintenance-oriented behaviors by the team members. The following list and short paragraphs summarize the features of effective meetings.

Introductions. The first time a team meets, everyone should introduce him or herself and state their goals for the team. Share your expectations for the team in one or two sentences. Do not waste time mentioning irrelevant personal details like favorite foods, cars, or pets. In every subsequent meeting (after the first) one of the team members should act as the team leader who would moderate the meeting and take notes to summarize the meeting. Ideally, this role should be shared equally between all the team members.

Promptness. Starting meetings on time is important to team morale and efficiency. It is absolutely essential that all team members know when and where team meetings will be held. If someone must miss or be late for a previously arranged meeting, it is their responsibility to contact <u>all</u> team members. In the event that a team member is tardy to a team meeting, it is suggested the team wait 10 minutes, and then the team leader should attempt to contact the missing team member(s). The meeting should start immediately after this contact attempt. The leader should summarize the team's progress for the tardy team member when (or if) he or she arrives. If the missing team member fails to explain his/her absence or does not have a medical (or other serious) excuse, the team should consider completing the report without him or her and turning it in without his or her name on it.

Review. At every meeting after the first one, the assigned team leader should review the status of the team and its progress toward its goals. Contested items and past conflicts should be mentioned along with successes and completed tasks.

Agenda. All meetings need an agenda with a timeline. The timeline can be accurate, approximate, or just an estimate. Agendas keep the meetings from breaking up into parties or other types of social gatherings. Ideally, a meeting agenda should be sent out 24 hours ahead of the meeting. In

ME 495, this may not always be possible or even necessary; however, the meeting agenda should always be part of the team leader's review.

Goals. The team leader should ensure that every team meeting has a goal so that everyone knows what needs to be done before the meeting ends. This goal can be developed as part of the meeting or, if it is obvious, can be merely stated by the leader. [The team must have a goal as well. Determining the *team goal* should be a *meeting goal* at the first team meeting.]

Minutes. Meeting minutes should be taken by the team leader of the meeting and distributed to all team members. They should be brief (less than half a page) but must always contain a list of meeting participants, the goal of the meeting, the tasks that were assigned, the individuals responsible for each task, and the time and place for the next team meeting.

Brainstorming. This is an idea-generating technique where all in attendance are asked to mention their ideas as they occur. No criticism of ideas is allowed during a brainstorming session. Brainstorming may be used whenever the team cannot determine what the next step or activity should be. In ME 495, brainstorming is commonly used whenever a team is seeking: a fair partition of the workload, answers to *scenario* letter questions, or ideas for the discussion section of the report.

Evaluation. This is the process that follows brainstorming, perhaps after a short meeting break. The pros and cons of each possibility are discussed, and a collective decision is reached on the approach(s) the team will follow. It is important for the team leader to be open minded and flexible for building a group consensus during a period of critical evaluation.

Place. Meeting places should be convenient and comfortable to all team members. In addition, meetings should not be interrupted unnecessarily. It is best to try to meet where your team will not be disturbed.

Interruptions. These can completely ruin a team meeting and spoil team morale. No one likes waiting while some else talks on the phone or to a passing friend. Try to meet where your team will not be disturbed. Develop simple rules that discourage interruptions. For example, you might agree that any team member who causes an unnecessary interruption will buy coffee or soft drinks for all the others.

Best Practices as a Team Member. Teams will only function well if the individuals who make up the team establish clear policies for managing both the team's tasks and human relationships. On effective teams, a high level of trust and respect is established, and communications are open and honest. To facilitate this type of team development, all team members must engage in certain activities and use certain skills. Although many of these amount to common sense and common courtesies, several important ones are listed below with a short explanation.

Be truthful. Do not hide essential information even if it is embarrassing. If you must miss a team meeting, do not know how to do something, or have some other type of conflict, tell your team members. It is better for the team to work through problems early than to panic the night before the report is due because an important item was left undone.

Be polite. Rudeness, shouting, and arguing do not have a positive impact on team performance.

Communicate frequently with your team members. Let your team members know what you are doing, especially when you've completed something. This may inspire them to finish their part of the team project.

Only accept jobs you can complete. Know what you can do and be realistic about what you can complete. Be willing to learn new skills if your team needs you to contribute more.

Complete all jobs you accept. Failure of an individual to complete his or her work on (or ahead of) schedule is the quickest way to destroy a team's effectiveness. This is perhaps the most important individual activity necessary for successful teamwork.

Seek an even partition of work on the team. This ensures fairness and team efficiency. Accept your fair share of the work; do not try to do everything; do not try to avoid making an important contribution.

Be on time to team meetings. Although this is part of being polite, it is important enough to emphasize repeatedly because it affects team efficiency and morale.

Stay focused at team meetings. Avoid clowning, withdrawing, or deflecting the work of the team by drawing attention to yourself or to irrelevant subjects.

Do not compete with your team members. Everyone on the team whose name appears on the report gets the same grade. Work to pull your team together, not apart.

Do not ignore conflict. Disparate opinions and approaches are essential for ensuring that major errors do not end up in your laboratory report. Be willing to openly discuss and resolve all problems. Promote correct ideas, decisions and answers, even when they are not your own.

Direct criticism at ideas, objects, or actions, not at individuals. Personal attacks always decrease team morale and always lower team effectiveness. Diversity (not divisiveness) within the team leads to better decision-making. The following list summaries the characteristics and activities of effective teams.

- *Team meetings start on time with all members present.*
- *Team members know the motivation for the actions of other team members.*
- *Team tasks are understood and accepted by all team members.*
- *Changes in priorities or approaches are developed collaboratively.*
- *Meetings are informal and relaxed but not boring.*
- *Meetings do not drag on and on with one or more team members completely disengaged.*
- *Discussion is focused on the current agenda item.*
- *Everyone participates in the discussion.*
- *Everyone listens to each other; all ideas are given a fair hearing.*
- *Independent critical thinking is encouraged.*
- *Criticism is frequent, open, and frank but is always intended to promote team progress.*
- *Disagreements are not suppressed but are settled openly.*
- *The team leader does not dominate nor does the team defer unduly to the leader.*
- *When decisions are reached, clear assignments are made and accepted by team members.*
- *Tasks are completed on or ahead of schedule.*
- *Brief meeting minutes are distributed to all team members.*
- *Groupthink is avoided.*

Groupthink is produced by the social desire of human beings to conform to the group they currently find themselves in. Groupthink leads to closed-mindedness, rationalization, suppression of ideas, and overestimation of the group's capabilities and knowledge. Groupthink produces poor laboratory reports because…

- *only a few alternatives or discussion items are ever considered,*
- *there is a tendency to not reexamine initial decisions,*
- *no time is spent exploring how to make rejected alternatives desirable,*
- *no effort is made to obtain information from experts outside the group (i.e. GSIs, faculty),*
- *incoming information is screened for supporting facts alone (other information is ignored), and*
- *potential difficulties are not discussed so contingency plans are not developed.*

Groupthink is the bane of ME 495 teams. Groupthink can be avoided by having an open group climate, by consulting the available outside experts (GSI, faculty), and by insisting that all team members are critical evaluators and not mere robotic task finishers.