GEORGIA INSTITUTE OF TECHNOLOGY
WOODRUFF SCHOOL OF MECHANICAL ENGINEERING
Fall term, 2020-08-18
ME 6449: Acoustic Transducers and Signal Analysis, at GT-Lorraine

Important: Text in purple is entered or adapted as a consequence of the Fall 2020 Covid-19 circumstances. If any circumstances change during the semester, imposed by Georgia Tech, the Government or as Force Majeure then an update to this syllabus will be posted on Canvas.

Instructor: Prof. Dr. Nico F. DECLERCQ
Availability: After class + Open door policy (it may be useful to make an appointment by email however, Office: GTL 224
NOTE: because of COVID-19 restrictions, my open door policy is different : please make an appointment so we can chat online, or if really needed make an appointment in a safe manner).
Email: Declercq@gatech.edu

Course objectives:
To expose graduate students to some basic instrumentation and methods of signal analysis used in ultrasonics, acoustics and vibrations

Textbook: None required, you will receive handouts (see also recommended references attached in case you want extra literature)

Contents (indicative, some changes will be made as we move on):
Part 1: FOURIER/SIGNAL ANALYSIS
Part 2: LASER ULTRASONICS TO GENERATE AND DETECT SOUND
Part 3: PIEZO-ELECTRICITY AND CLASSICAL TRANSDUCERS
Part 4: STUDENT PROJECTS

Useful references (not limited)

Transduction:
• Fundamentals of Acoustics, Kinsler, Frey, Coppens, Sanders (Wiley 1982) – Chapter 14
• Electroacoustics, F. Hunt, AIP / ASA
• Underwater electroacoustic measurements, R. Bobber, Peninsula Publishing, 1988

Piezoelectricity and ultrasonic transducers:
• Acoustic Waves, G. Kino, Prentice-Hall, 1987
• Nondestructive Evaluation, Bray and Stanley, CRC, 1997
• Sensors and Transducers, Ian Sinclair, Newnes, 2004

Audio instrumentation:
Noise Control, C. Wilson, Krieger (1994) Chap. 3

Laser ultrasonics:
• Laser ultrasonics, Scruby and Drain, Adam Hilger (1991)

General:
• Acoustical Measurements, L. Beranek, AIP/ASA

Signal Analysis:
• Engineering Applications of Correlations and Spectral Analysis, Bendat and Piersol, Wiley (1980)

REQUIRED SILENCE IN CLASS: Class-participation (being present, paying attention, asking questions, ...) is perfect. What is not OK is “noise”. Note that I accept many more students in class than normally intended, which is my favor to you; however, each student must be able to follow this class comfortably. You all pay tuition and should not be disturbed by others. Therefore, be quiet so that your classmates can listen to their teacher without being distracted.

GT Academic Honor Code

Students are required to follow the Georgia tech honor code which may be found at: http://osi.gatech.edu/content/honor-code

Students are allowed to collaborate on out of class assignments but must include specific attribution to any help they received. Work turned in must be your own work not copied from anywhere else (including solution manuals) and you must state what type of assistance you received while completing the assignment.

CANVAS
Your instructor uses CANVAS to send you messages and your results of homeworks and quizzes. Note: if canvas estimates your final mark you need to ignore it because to calculate the final mark you need to use the proper weights as give earlier in this syllabus

Attendance at lectures is required. This class will be taught live in class and students are supposed to attend. Classes will also be recorded to allow students who find themselves in quarantine due to the Covid-19 situation, to virtually attend classes.

Tasks and Grading weights:
All tasks will be submitted on canvas.
There will be no final exam. Instead there will be 4 quizzes. Each quiz is closed book and close notes. Read very carefully what each quiz covers! In case of a lock-down or any other type of Force Majeure which would not allow the organization of a certain quiz in class, then this quiz will be replaced by a remote quiz which will be assigned at the beginning of the regular time slot and will be due through canvas at the end of the time slot. In such case (i.e. if the test is taken by all students online), the test will be open book and open notes; in all other situations the tests are closed book and closed notes.

Each assignment must be submitted via Canvas. Each quiz should be made on paper in class and each sheet should clearly indicate your full name. Each student, when ready and before the end of the allocated time slot, must scan his exam sheets using his own equipment and submit via canvas not later than the end of the exam time slot. The paper sheets should be disposed in a dedicated box before leaving the class. Your teacher will only grade your submitted files on Canvas and not your paper documents. The paper documents will only be kept for future reference, if ever needed.

**Homework**: You will receive a few small homeworks and 2 extensive homeworks. They will be graded according to the same weight however. For the homework requiring simulations you are expected to work in Matlab. Knowing how to work with matlab is a skill that is very beneficial for your future career and for your continuation as a student on the Georgia Tech campus. There is much online material, including youtube movies, to learn the basics of programming in Matlab. I suggest you work on those skills as soon as possible so that you will be well-prepared for the homework.

All tasks will be submitted on canvas.

**Final project:** (deliverable : professional report, not later than 7 days after our last class)

The report must be made professionally. The length indication is 5 pages per student (word document, 5 A4 pages (single space, letter size 12 - This may include figures but not more than necessary and not larger than needed) per student, written in your own words and not directly copied from anywhere else). If you work in a group with n-students, then the total length is n*5 pages. Groups should not be larger than 6 students.

Task: study a topic related to this course and write a report (text and images as appropriate) which is at the level of our peers. **TOPIC**: the topic must be substantially related to this class and may cover chapters of textbooks or other material you can find in journals, scientific books or other sources, or a subject that you find interesting in the field of signal analysis, transduction, sound generation, sound detection etcetera. A list of examples will be distributed on Canvas during the semester, the list will not be limited, therefore you may propose other topics by email.

**Grading policy:**

*For each exam, you will receive a numerical grade on T-square. These numbers must be interpreted as:*

- 90%-100% : A
- 80%-89.99%: B
70%-79.99%: C  
60%-69.99%: D  
below 60% : F

So my CUT-OFF for an A is 90%, for B is 80%, for C is 70% etc.

Short Homework is graded as follows: full marks if correct, 0 if not correct, 50% if you give an answer but the answer is not correct.
Extensive Homework is graded according to the ABCDF grades described above.

IMPORTANT: if canvas estimates your final mark you need to ignore it because to calculate the final mark you need to use the proper weights as give earlier in this syllabus

WEIGHTS:

- **Quiz 1**: covers all the material studied between the first class and the class day prior to quiz 1.  
  Weight of quiz 1: 20%
- **Quiz 2**: covers all the material studied between the first class and the class day prior to quiz 2.  
  Weight of quiz 2: 20%
- **Quiz 3**: covers all the material studied between the day after quiz 1 and the class day prior to quiz 3.  
  Weight of quiz 3: 20%
- **Quiz 4**: covers all the material studied between the day after quiz 2 and the class day prior to quiz 4.  
  Weight of quiz 2: 15%

**Homework**: 20% (deliverable: professional reports with matlab files)

**Final Project**: 5% (deliverable: professional report, not later than 7 days after our last class)

**CALENDAR:**
We follow the GT Lorraine Calendar.
The exact dates of the quizzes will be defined and communicated at least one week before each quiz. There will be no change of the dates from students’ requests. If specific requests, please contact the Dean of Students at GT Lorraine asap.

**ADDENDUM:**
Specific additional information as syllabus insert (August 14, 2020). This information is up to date as of today, but may change during the semester. Any changes will be communicated to you by Georgia Tech and/or GT Lorraine
Expectations and Guidelines

Each of us has a responsibility to ourselves and our fellow Yellow Jackets to be mindful of our shared commitment.

- We are all required to wear a face covering while inside any campus facilities/buildings, including during in-person classes, and to adhere to social distancing of at least 6 feet. If an individual forgets to bring a face covering to class or into any indoor space, there will be a clearly marked supply of these in each building. If a student fails to follow Georgia Tech's policies on social distancing and face coverings, they will initially be reminded of the policy and if necessary, asked to leave the class, meeting, or space. If they still fail to follow the policy, they may be referred to the Office of the Dean of Students. Information on the Institute's policy on face coverings.

- Students are expected to sit in assigned seats and to come to class only on days that are assigned to them.

- Papers, projects, tests, homework, and other assignments will only be accepted in electronic form unless the assignment is a physical artifact. Additional information is available in the Student Guidebook.

Instructor Illness or Exposure to Covid-19

During the fall 2020 semester, some faculty members may be required to quarantine due to exposure or isolate due to a Covid-19 diagnosis. Some disruption to classes or services is inevitable, but Georgia Tech is making every effort to ensure continuity of operations. As is the case in any semester, faculty may cancel a class if they have an illness or emergency situation and cover any missed material at their own discretion. If an instructor needs to cancel a class, they should notify students as early as possible.

Faculty who are staying home due to symptoms should monitor their health closely and consult with their school chair to determine if remote instruction or substitute instruction is most appropriate for the course. If they need to cancel a class repeatedly, a backup will be supplied in the form of a temporary substitute instructor or asynchronous work. No course will be canceled after the first class has occurred.

If you have not tested positive but are ill or have been exposed to someone who is ill, please follow the Covid-19 Exposure Decision Tree for reporting your illness.
Student Illness or Exposure to Covid-19

During the semester, you may be required to quarantine or self-isolate to avoid the risk of infection to others. Quarantine is the separation of those who have been exposed to someone with Covid-19 but who are not ill; isolation is the separation of those who have tested positive for Covid-19 or been diagnosed with Covid-19 by symptoms.

If you have not tested positive but are ill or have been exposed to someone who is ill, please follow the Covid-19 Exposure Decision Tree for reporting your illness.

During the quarantine or isolation period you may feel completely well, ill but able to work as usual, or too ill to work until you recover.

Remote courses and remote class sessions during hybrid courses. Unless you are too ill to work, you should be able to complete your remote work while in quarantine or isolation.

In-person courses and in-person class sessions during hybrid courses. When in isolation or quarantine you will be unable to attend in-person course sessions but your instructor may require you either to participate in the course remotely, complete some complementary work that parallels what you are missing in class, or make up some class work when you return.

If you are ill and unable to do course work this will be treated similarly to any student illness. The Dean of Students will have been contacted when you report your positive test or are told that it is necessary to quarantine and will notify your instructor that you may be unable to attend class events or finish your work as the result of a health issue. Your instructor will not be told the reason. We have asked all faculty to be lenient and understanding when setting work deadlines or expecting students to finish work, and so you should be able to catch up with any work that you miss while in quarantine or isolation. Your instructor may make available any video recordings of classes or slides that have been used while you are absent, and may prepare some complementary asynchronous assignments that compensate for your inability to participate in class sessions. Ask your instructor for the details.

CARE Center, Counseling Center, Stamps Health Services, and the Student Center

These uncertain times can be difficult, and many students may need help in dealing with stress and mental health. The CARE Center and the Counseling Center, and Stamps Health Services will offer both in-person and virtual appointments. Face-to-face appointments will require wearing a face covering and social distancing, with exceptions for medical examinations. Student Center services and operations are available on the Student
Center website. For more information on these and other student services, contact the Vice President and Dean of Students or the Division of Student Life.

Accommodations for Students at Higher Risk for Severe Illness with Covid-19

Students may request an accommodation through the Office of Disability Services (ODS) due to 1) presence of a condition as defined by the Americans with Disabilities Act (ADA), or 2) identification as an individual of higher risk for Covid-19, as defined by the Centers for Disease Control (CDC). Registering with ODS is a 3-step process that includes completing an application, uploading documentation related to the accommodation request, and scheduling an appointment for an “intake meeting” (either in person or via phone or video conference) with a disability coordinator.

If you have been approved by ODS for an accommodation, I will work closely with you to understand your needs and make a good faith effort to investigate whether or not requested accommodations are possible for this course. If the accommodation request results in a fundamental alteration of the stated learning outcome of this course, ODS, academic advisors, and the school offering the course will work with you to find a suitable alternative that as far as possible preserves your progress toward graduation.

Course Homeworks/Assignments/Papers

All course assignments will be submitted electronically via Canvas. Point students to where these can be found in Canvas. If your students are expected to submit physical artifacts, share information on how they will be able to do this.

END OF SYLLABUS