ME 6449: Acoustic Transducers and Signal Analysis, at GT-Europe

1. **Instructor:** **Prof. Dr. Nico F. DECLERCQ**
   Availability: After class + Open door policy (it may be useful to make an appointment by email however, Office: GTE 224).
   Email: Declercq@gatech.edu

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

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

4. **Contents** (indicative, some changes will be made as we move on):
   Part 1: FOURIER/SIGNAL ANALYSIS
   Part 2: Nondestructive Evaluation
   Part 3: LASER ULTRASONICS TO GENERATE AND DETECT SOUND
   Part 4: PIEZO-ELECTRICITY AND CLASSICAL TRANSDUCERS
   Part 5: STUDENT PROJECTS

5. **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)
- Discrete Time Signal Processing, Oppenheim and Shafer, Prentice Hall (1989)
- The Fourier Transform and its applications, Bracewell, Mc Graw Hill (2000)

6. **REQUIRED SILENCE IN CLASS** : Class-participation (being present, paying attention, asking questions, …) is perfect. What is not OK is "noise". 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.

7. **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.

8. **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 given in this syllabus

9. **Attendance** at lectures is required.

10. **Tasks and Grading weights:**
(quizzes are mentioned in the 'weights' section below)

Only online submissions are allowed
All tasks will be submitted on canvas, except exams. If you have a handwritten task, you can take photos an submit them via canvas.

Homework : You will receive a few small pieces of homework and two extensive homework. 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 to be well-prepared for the homework.

Final project and Presentation: (deliverable: professional report, not later than seven days after our last class; and a presentation in class of around 15 minutes per student, to be scheduled later)

The report must be made professionally. The length indication is five 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), written in your own words and not directly copied from anywhere else. If you work in a group with n-students, the total length is n*5 pages. Groups should not be larger than five students.

Task: study a topic related to this course and write a report (text and images as appropriate) at your peers' level.

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.

Presentation: per group, 15 minutes per student. (5-6 students per class time slot)

Grading policy:
For each exam, you will receive a numerical grade on canvas. 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. The exam is closed notes and closed book.
Weight of quiz 1: 20%

-**Quiz 2** : covers all the material studied between the first class and the class day prior to quiz 2. The exam is closed notes and closed book.
Weight of quiz 2: 25%

-**Final Exam** : covers all the material studied this semester. The final exam is open book and open notes.
Weight of the final exam: 25%

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

-**Final Project**: 10% (deliverable : professional report, not later than 7 days after our last class. A presentation of 15mins per student is also required, to be scheduled later)

11. **CALENDAR:**
We follow the GT Europe Calendar.
The exact dates of the quizzes will be defined and communicated at least one week before each quiz.
QUIZ 1: around September 12,

12. **AI Usage Policy in This Class**
Students are permitted to use AI as a supplementary tool for learning, alongside lectures and course literature. AI is considered as an artificial colleague that you may discuss with. In other words, you may consider AI as a peer with whom you can engage in intellectual discussions, keeping in mind that its responses may not always be accurate, and part of the learning experience lies in critically evaluating the information.

However, AI must not be used to generate code, complete assignments, produce reports, or perform any other similar creative tasks related to coursework in this class. These activities must be carried out independently to ensure genuine understanding and skill development.

END OF SYLLABUS