Boston University, College of Engineering

Course title: **Engineering Device Physics**
Course # : **me506 (last year the course was numbered as me500)**
Related info: This course is listed in mechanical engineering, although it may well appeal to students from other engineering and science backgrounds, since a wide range of devices will be covered. Some of these devices will certainly be "mechanical", but many others will also be based on optics, electromagnetism, circuitry, chemistry, and even quantum mechanics, plus some biological based "devices." The present class in the Spring of 2020 is scheduled to meet on Tu & Th, 3:30pm-5:15pm, in Photonics 210, at 8 Saint Mary's.
Professor: Dan Cole
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Office: Mechanical Engineering Department, 15 Saint Mary's Street, Rm. 133
Directions to office: Go in at 15 Saint Mary's, bear right, go down the long narrow corridor, with the glass walls on the left, through the double doors, and my office is on the left, Rm. 133. My office is very close to the ECL computer lab.
Office hours: 1:00-2:15pm Monday and 10:00-11:15am on Wednesday. See above for directions to my office. If you cannot make those hours, please feel free to contact me by email to arrange another time, or, just stop by and see if I am free. Again, my email is dccole@bu.edu.

Catalogue description: Senior or graduate standing in the engineering, physics, or the chemistry disciplines, or consent of instructor. Topics include many sensors and actuators, including accelerometers and piezoelectric devices, as well as many other electromechanical devices, plus lasers, quantum dots, atomic force microscope, ellipsometry, plasma etching, advanced semiconductor based devices, scanning electron microscopes, and open to other student suggested directions. Such devices are used considerably in engineering, science, and technology, as well as in commercial high "tech" products, and for instrumentation and measuring purposes. Many devices will be taken apart and analyzed in terms of the operation, physics, design, device optimization, plus considerations of possible deviations from the original design. The intent here is that a confident mastery of these devices will improve the use and application of these devices for engineers, as well as provide a guide where jobs might be obtained in the use and possible enhancements of these devices. About 20 physical demonstrations will be given during the course.

Discussion of the course content

The course will examine a number of engineering/physics based devices that most of us know the names of, but likely only have an inkling as to how they really work. The intent is to fix that last aspect, so everyone ends up a very clear understanding of these devices, and perhaps could even design such a device, or even improve on present designs and features. Here are some devices likely to be covered: accelerometer, piezoelectric based devices, lasers, laser tweezers, ellipsometers, atomic force microscope, scanning electron microscope, a certain "motor" in the human body, and of course various types of sensors, etc. By knowing how these devices work, it should certainly make everyone more competent at making use of them in designs and

experiments. In addition, this knowledge may prove to be extremely helpful for jobs in industry, whether you are working to improve a device in a unique way, or, to make the best use of the device in an application.

The intent is to cover about one device per class, although sometimes having this run over into a second class, depending on the topic. Some classes will be spent entirely on the general theory that might pertain to a set of devices, such as for key aspects of quantum mechanics. About 20 physical demonstrations of devices are planned for the course, so folks can clearly see how the devices works. Basic facts will be gone over, as well as the theory of operation.

In groups of about three students, 10 minute presentations will be given in most classes, on devices that have been discussed the earlier week. Specific questions will be assigned to the groups to be answered in the presentations. The group can choose from several questions to be answered, including physical questions, economics of the device, or applications not earlier discussed that might be of interest. Demonstrations are always welcome.

Four written homeworks will be assigned during the course, all asking questions to be answered on the device demonstrations already given.

A class project, carried out in groups of about three students, will be presented at the end of the semester. The criteria will be to present a demonstration of a device of interest to the group, describe the underlying theory, and the economics of the device.

The **grading** will be:

(1) Midterm (25%)
(2) Final (25%) (material from midterm on)
(3) Final project (25%) (in groups of three)
(4) Class presentation (not counting final project) (10%)
(5) Class participation (discussions) (5%)
(6) Homework (10%)

For each of these you will receive a numerical grade. The final grade will be computed using the weights above. This grade will then be converted into a "letter" course grade in the following way: 80=>83.33 would be a B-, 83.34=>86.66 would be a B, and 86.67=>89.99 would be a B+, and likewise for the other ranges of 70=>79.99, 90=>99.99, etc.

Please note that there is no book to purchase for this course. All material will be from lecture notes and reading / viewing assignments that can be found on the web.

The midterm will be on class #13 (total of 27 classes), which falls on Thursday, 3/5/20. Spring break occurs the following week.