Boston University, College of Engineering

Course title: **Engineering Device Physics**
Course # : **me500 (in later semesters will likely become me506)**
Related info: This course is listed in mechanical engineering, although students from other backgrounds in engineering and the sciences are most welcome to take it, since the material will involve a wide range of devices. Yes, certainly many of these devices will be "mechanical", but just as many, if not more, will also be partly or solely based on optics, electromagnetism, chemistry, etc., including some biological based "devices." The present class in the Spring of 2019 will meet on Tu & Th, 3:30pm-5:15pm, in room 202 at 9 Saint Mary's Street (Photonics Building).
Professor: Dan Cole
Contact: **email:** dccole@bu.edu (best way to contact). **Phone:** (617) 353-0432 (my cell if you really need to call me)
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: 9:00-10:30am on Monday, and 3:00-4:00pm on Wednesday, except for holidays. 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. Engineering continues to become more and more technical. A confident mastery of physics, design, development, and optimization often requires a fairly deep understanding of the physics involved, whether for processes, devices, or operations. This course aims to satisfy this need by providing the needed physics background to many engineering physics applications, but then using this knowledge to optimize on the best possible device designs possible. Typical topics include the details of electromechanical sensors, laser design, quantum dots, atomic force microscope, ellipsometry, plasma etching, advanced semiconductor based devices, and open to other student suggested directions. Devices taken apart will be presented, then the operation, physics, design, and optimization will be analyzed, as well as potential deviations from the original design.

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, but, we will allow the list to also depend, to some extent, on student interest: accelerometer, piezoelectric based devices, lasers, laser tweezers, ellipsometers, atomic force microscope, scanning electron microscope, a certain "motor" in the human body that I want to save as a surprise in the course, 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, I suspect 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.

My 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. I hope to have demonstrations for many of the devices, so folks can clearly see how the device works. Basic facts will be gone over, as well as the theory of operation. At the end of class, I will mention three or four topics, related to the device, that a group of three students will address to the class in a week. The topics will likely range from one on economic importance, answering a physics question I might pose, or doing your own demonstration. Should be interesting!

The **grading** will be:

(1) Midterm (27.5%)
(2) Final (27.5%) (material from midterm on)
(3) Final project (30%) (in groups of three)
(4) Two class presentations (not counting final project) and class participation (15%)

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.

I am thinking of having the midterm on class #13 (total of 27 classes), which falls on Thursday, 3/7/19. Spring break occurs the following week.