# *Prepare Students for Research in Electrical Engineering and Life-Long Learning*

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Graduate electrical engineering courses that I teach require a substantial mathematical foundation and use computing to simulate various dynamical processes to illustrate behavior of some complex systems.

In the first few weeks of the semester, we build the foundation, reviewing prerequisite material and ensuring that everybody in the student group has approximately the same knowledge in those matters. All students in the course must have proficiency in the foundations they had to obtain their undergraduate engineering degrees. It is not always an easy task. The class is often composed of two kinds of students: those who recently finished their undergraduate studies and can handle the math and computations easily and those who come to us after working in the industry for several years. At the beginning of the course, we discuss those matters. I encourage those who might have forgotten the more difficult subjects to meet me for an individualized review session, identify difficult problems, and give those students an individualized tutorial. An individualized session with such students gives them a lot of motivation and encouragement because they can feel that they are not "thrown into the deepwater" to "sink or swim," but that the professor is sensitive to their individual needs and concerns.

As the course progresses, I try to engage students in the discussions of their work, for example, by allocating extra points for class presentations of the best homework solutions. To guide students, I usually first give a shorter test – called a 'quiz,' which has a lower % value in the grade calculation, and then follow up with a real test a couple of weeks later, this time having a much higher % value in the grade calculation. This approach works because students first try a more straightforward test and then later do a more challenging test.

In the second part of the course, I direct students toward the development of their research projects. Students are asked to propose their project topics by writing short proposals, describing the idea, and providing literature references, usually five or more reference papers. I review the proposals and approve them or ask for modifications. Students then work on these projects, developing computational algorithms and the results of their simulations. Projects are aimed at various technological challenges, such as estimating the satellite's position from ground measurements, controlling a complex network, or – more recently – simulating and predicting the COVID epidemic. Projects are presented to the whole class at the end of the semester. Some of them are presented for graduation requirements in a Master's degree in Electrical Engineering.

The same model has been developed and practiced in the framework of Distance Learning by using pre-recorded lectures and videos, even with a lot of mathematical formulas and computations, and with Blackboard and ZOOM interactive sessions.

This overall approach motivates the students to work on difficult problems and maintain a pattern of studying material beyond the course, even after they graduate and continue to do research. That is, it motivates them to pursue the objective of life-long learning.