Teaching Statement

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Engineering is a discipline about creation. Theodore von Karman said, *"Scientists study the world as it is; engineers create the world that has never been."* One of the most distinct features of engineering is that it synthesizes knowledge to produce an unprecedented object. This could be a new device, a material, a technology, or a perception that change the world. Therefore, I believe that teaching in engineering should inspire and guide students so that they develop not as a passive follower or supporter but as an active creator and leader. To accomplish this, there are three essential tenets in my teaching philosophy: (i) help students to recognize and understand the fundamental concepts and the underlying key ideas, (ii) guide students to develop their critical thinking skills, and (iii) share my enthusiasm for engineering with students.

Great inventions in science and engineering are often based on a simple idea, which originates from an essential concept and a fundamental principle. Once a new insight is established, it is extended and enhanced to provide a novel solution to various sophisticated engineering problems. However, students are commonly overwhelmed by advanced technical terminologies and complicated mathematical expressions, and they do not recognize the underlying fundamental concepts and principles that create what students find in the literature. Without understanding the key idea that makes possible the engineering knowledge, a student cannot grow as a creative engineer. My first teaching goal is to help students develop their individual insight into engineering problems and to help them create their own solutions.

Therefore, when I lecture on an engineering subject, I follow a research approach. First of all, I define a concrete problem that can be tackled by a lecture, and I explain the related background. Then, I encourage students to talk freely about how to approach the problem, and let them extract the key strategy through the discussion. The remaining step is transforming the fundamental idea into a clear solution by applying mathematical facts and physical laws rigorously. Finally, I evaluate the established solution with students by discussing the desirable features and the limitations. Throughout the lecture, I make a clear distinction between the initial step to find the core idea from fundamental concepts and the following steps that realize it correctly and rigorously. This helps students to establish their own insight into the given problem.

Critical thinking is another required skill for an engineer. It is an intellectual process of acquisition of information and facts, and evaluation of them to obtain a well-justified conclusion. This is particularly important for an engineer since it enables one to analyze a given problem, conceptualize one's idea, evaluate feasible answers, and share the results with others in a systematic way. An engineer with well-developed critical thinking skills raises a critical question, and gathers related information in order to reach a conclusion. This is in contrast to mere possession of a set of skills and routine practice of them, which occasionally characterize a bored student.

Throughout my lectures, emphasis is made on active participation of students. This does not mean that every student should ask a question or make a comment in the class room. This signifies that students follow the logical flow of the aforementioned lecture steps in their own thinking. What I want to avoid in my lectures is that students merely copy sentences from the blackboard into their notes, and memorize what they hear. The intellectual interchange with students can be made by asking questions that stimulate their curiosity and inspire their thinking to construct knowledge. These questions can be plain; "why is a certain approach better than others?" "what could be a next step in this development?" or "which assumptions have been made to this result?" By answering these questions students are actively involved in the class, and they develop their critical thinking skills through logical reasoning.

Finally, I try to share my enthusiasm about engineering with students. I am currently lecturing on a graduate course in the University of Michigan, *AE740 Analytical and Computational Dynamics*, under the supervision of my advisor. This gives me a valuable opportunity to establish my teaching philosophy. As a junior graduate student, I guided three undergraduate students in an individual research project required for their degree. I also assisted my advisor in developing course notes, of more than 300 pages, for *AE240 Performance of Aircraft and Spacecraft* by writing several sections. From my own experiences in teaching and learning, I have found that if students do not have a passion for the subject, they never learn efficiently and intensively.

The process of creation in engineering is not often smooth and predictable. An unexpected problem may confound an engineer for a long time before he/she finds a successful solution. Passion for learning and enthusiasm for the subject are motive forces to overcome obstacles. Unfortunately, one's emotions cannot be taught or learned by logical explanation in the classroom. However, I believe that sharing my enthusiasm for engineering with students inside and outside of the classroom can motivate them.

I look forward to teaching engineering subjects to students throughout my career. It is my great pleasure to see a student develop as a creative engineer under my guidance. I am interested in teaching a large number of subjects in engineering and mathematics related to dynamics and control, varying from elementary mechanics to advanced nonlinear control theory. I also would like to organize a computer programming class so that students can develop programming skills in C, Fortran, and the parallel computing.