Shifting Gears in ME350

Students in the ME350 design class used to spend a good portion of their time learning failure theories and design components such as gears, bearings, and screws. For their class project, which constituted forty percent of their grade, instructors provided a list of standard components and all student teams worked on the same project (e.g. the design of an efficient elevator).

Now, under the leadership of Professor Sridhar Kota, the course has shifted gears. Today, students still learn how to select standard components, but also learn how to design non-standard components/sub-systems, and they are given the freedom to choose what kinds of projects they would like to work on.

"Starting from scratch, I teach them how to design a system for any mechanized motion," he explained. "And I let them have fun doing it."

After Kota provides examples of possible projects, students working in teams think of ideas for their own designs. They perform a patent search to ascertain that their idea has not already been implemented, and write a project proposal. Kota and his able teaching assistant, Charles Kim, whom he enthusiastically acknowledged for his contributions beyond the call of duty and his passion for engineering education, read the proposals to make sure that the scope and complexity are appropriate for the course.

Kota's guideline is straightforward. He asks, "Is it possible to frame this as a practical problem in terms of the theory I teach?" He stresses that all projects must deal with real-world constraints. If a team wants to design a tail-gate mechanism for a truck, for example, team members must be able to describe the truck or trucks on which their device will work, in order to meet real packaging constraints.

Once their proposals are accepted, teams create their unique system design using synthesis methods they learn in class (rather than tinkering by trial and error), model it in ADAMS (3D dynamic modeling software), and build a prototype in the student design lab. Students must also size each of the standard components such as gears, bearings, springs, and motors based on force analysis (using ADAMS). This adds realism to their component selection, rather than simply being a dry, end-of-the-chapter problem. The students' projects, along with projects from ME250 and ME450 design classes, are displayed during the ME Design Expo held each semester.

The underlying theory, Kota said, is to "capture the fundamentals needed to synthesize and analyze mechanized motions, be it a prosthetic knee mechanism or a manufacturing automation mechanism, and thereby offer the openness to create something unique that interests students."

Winter 2003 is the second semester Kota has taken this approach with his students. Previously, students in the fall 2003 class designed everything from an inchworm toy to a mechanized weight-lifting spotter, to an improved soccer ball kicker. Kota already feels the new approach has been very successful. Students are learning the basics of the entire design process, which prepares them for more advanced design projects down the road.

(Top) Many weight lifters prefer to bench press using free weights. The problem is that a human spotter is not always available. The "Pro Spotter 900" allows a weight lifter to safely bench press free weights (free standing) anytime he or she wants.

(Above) This redesigned soccer kicker offers a convenient, reliable, and tireless soccer companion that improves soccer lovers' skills and intuition. The goal was to produce a mechanism that could efficiently kick soccer balls at varied heights and speeds and that is not cumbersome or impractical.