# Training the next generation of power engineers

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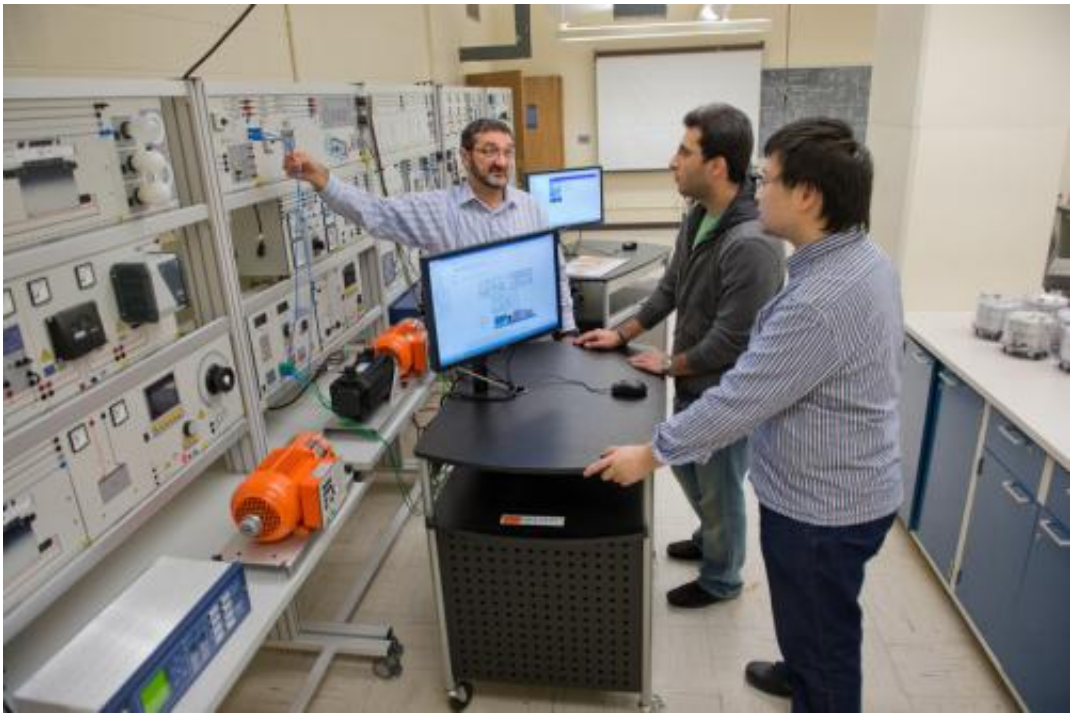

Professor Tomislav Bujanovic with students in Syracuse University's Smart Grid lab. Credit: Syracuse University's College of Engineering and Computer Science

Most people only think about the electricity that powers our homes and gadgets when it isn't there. When the power is humming, we tend to take it for granted. The trouble is, the network that delivers the electricity to keep our lights on, known as the grid, is sometimes pushed to its limits. High demand can lead to blackouts and increased operational costs. At

the same time, the grid is being asked to do more than just distribute power in today's interconnected world.

We need a new generation of power engineers to build and operate a "smart grid" that incorporates renewable energy sources, advances in control systems, communications, signal processing and cybersecurity. Syracuse University's College of Engineering & Computer Science has taken up the charge to educate and prepare the smart grid workforce for the future.

When it comes to educating students about complex subjects like this, it's not just what you teach, but how you teach it. That's why Professors Tomislav Bujanovic and Prasanta Ghosh of the College's Electrical Engineering and Computer Science department have made the pedagogy of their power engineering track a priority.

The College offers modernized power courses and new smart grid courses to graduate and undergraduate students. It also hosts a smart grid lab that provides hands-on experience. The courses and the lab were developed using grants from the Department of Energy.

In a recent paper presented at the Conference of the American Society for Engineering Education, Bujanovic and Ghosh provide examples of the hands-on experiments electrical engineering students are conducting as part of their undergraduate coursework. Students apply the theoretical concepts they have learned in the classroom to control a machine's torque, speed, and position using a digital controller designed in Matlab Simulink and dSpace real-time interface hardware. Students demonstrate what they have learned from the hands-on experiment by analyzing their observations and writing a professional report in which they are required to communicate technical material effectively.

By integrating the concepts learned in the classroom with hands-on

experiments, students gain a more thorough understanding of the topic. Introducing real-world application of engineering concepts at the undergraduate level and providing them access to a world-class smart grid lab sets this program apart from electrical engineering courses at other institutions.

Beyond learning the science of power engineering, students also learn to work as a team to complete their experiments. Bujanovic describes how this skill will be vital to those in the smart grid workforce:

"The complexity of the smart grid necessitates the expertise of many people of many different disciplines. It is not possible for one person to be an expert in everything. This means that strong teamwork skills are absolutely essential to a successful career working in contemporary power engineering and on the smart grid."

Finally, a key element of the pedagogy is an emphasis on the importance of open-minded, lifelong learning. Students are provided with the knowledge and skills to launch their careers in today's world. They must also understand that their continued success in the field of engineering hinges on their ability to learn new concepts and new technologies. The "state-of-the-art" in any given field is constantly in flux, so a successful engineer must master the ability to remain curious and learn continuously throughout their life to remain relevant.

At first blush, learning the skills that will keep our lights on and upgrade the grid can seem daunting, but with the College of Engineering and Computer Science's approach, students gain a firm grasp of the subject matter and many become passionate. An overwhelming majority of electrical engineering students at SU find this track attractive. 95 percent of graduating electrical engineering students have taken advantage of the power engineering track in the past year.

**More information:** For additional details on Bujanovic and Ghosh's pedagogy, check out their paper, "Laboratory Experiments for Enhanced Learning of Electromechanical Devices."

Provided by Syracuse University