

Teaching Application of Power Electronics in Power System Analysis Course

M.M. A. Rahman, Member ASEE
Grand Valley State University
Grand Rapids, MI, rahmana@gvsu.edu

This paper presents teaching of power electronics concepts in a traditional power system analysis course. Power system analysis is one of the multiple foundational courses on power engineering in almost all Electrical Engineering programs around the world. At Grand Valley State University (GVSU), it is the only course in power engineering offered to Electrical Engineering students during a 12-week summer semester in junior year. This course covers the fundamental concepts and their applications in all three sections of a modern power system namely generation, transmission, and distribution systems. In recent years, there has been a significant integration of power electronics in modern power systems. However, at GVSU power electronics is a graduate course and it is also taken by some senior students as an elective if they have a very deep interest in it. Hence, attempts have been made to get all Electrical Engineering students, not only the willing seniors, introduced to power electronics and its applications in all three sections of a power system. These include teaching some power system concepts with applications of power electronics and administering course projects that utilized power electronics. The pedagogical challenge is to enhance students' learning of modern power system and revolutionise their vision. This paper shows how it enhanced and changed students' perception about the scope of power engineering.

A recent study published by the National Academy of Engineering noted that the electric power systems are a technical wonder; and electricity and its accessibility are the greatest engineering achievements of the 20th century, ahead of computers and aeroplanes. Historically, Electrical Engineering started with power engineering that deals with the generation and distribution of electrical energy. With the advent of technology power engineering evolved into many technological areas of Electrical Engineering such as power systems analysis, power electronics, control engineering, smart-grid technology, nuclear power engineering, renewable energy technology, etc. In present-day industry, it is almost impossible to totally separate one of these areas from others. As an example, a modern power system cannot be implemented without the application of power electronics and control systems. When a student graduates and then goes to work in a power industry, he will immediately find that power electronics is a part and parcel of a modern power system. It is impossible to understand the functions of its component without a sound knowledge of solid-state switching. Therefore, some fundamental knowledge of power electronics and example of its application are essential in university curriculum. In our power system analysis course, therefore, we tried to introduce power electronics primarily in a qualitative and schematic manner so that the students can understand the basic operation of the whole system. These includes introduction to rectifiers, switching regulators, chopper circuits, inverters, solid-state relay and protection circuitry, etc. along with their applications as appropriate. This paper presents this pedagogical approach by highlighting how power electronics were taught to enhance students learning of contemporary renewable energy topics in power system analysis. The assessment of this pedagogical experience will be also presented.