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Power semiconductor device, course contents revisited.

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The skills needed to build next-generations of power semiconductor devices and integrate them into power electronic systems require proper education and training of engineering students both at the undergraduate and graduate levels. Therefore, a curriculum that includes courses, modules, and laboratory session becomes an essential tool to acquire the needed skills and training. The curriculum must also integrate industry-relevant analysis and design techniques and computer-aided design (CAD) tools. A successful implementation of such advanced curricula is expected to position the US industry at a higher competitive edge above the rest of the world.

To be able to propose a viable curriculum, we needed to know the current state of the curriculum in the US and abroad. We conducted a study to evaluate the contents of undergraduate and graduate courses and laboratory components in power semiconductor device taught in US universities and abroad. The study confirms that there are few educational programs, in the US, that offer courses in this area. The widely recognized energy conversion systems curriculum developed and offered through the consortium of universities for sustainable power (CUSP)™ by the University of Minnesota is primarily focused at the systems level with very little coverage on power electronics components and technologies.

The study shows that, currently, silicon is the industry workhorse for building power electronic devices. Although silicon has adequately addressed the needs of the power electronic industry until now, it may not be able to do so in the future. Next generation systems will require the ability to handle very high power and operate at much higher temperatures. With silicon technology reaching its material limits, new material technologies, such as wide energy band gap (WBG) semiconductors, become inevitable. A successful adoption of WBG technologies in power electronics systems will require new circuit topologies, new system design approaches, and efficient thermal management techniques. Reliability of the power electronics systems must be addressed at the application-level including interactions with energy sources and non-linear loads. To address the above issues, we propose a new curriculum, where course contents, required prerequisites, laboratory experiments, and certificates for graduate and undergraduate programs are presented. To address science and technology related issues, not only component-level physics and fabrication are covered, but also thermal management, temperature effects, reliability, power packaging, modeling, and systems integration are addressed. This main purpose of this study is to develop an educational program that can meet the future needs of the power electronic industry.