ELECTRIC POWER ENGINEERING EDUCATION RESOURCES: 2015-16 US AND CANADIAN UNIVERSITY SURVEY RESULTS

REPORT FROM THE POWER AND ENERGY EDUCATION COMMITTEE OF THE IEEE POWER & ENERGY SOCIETY

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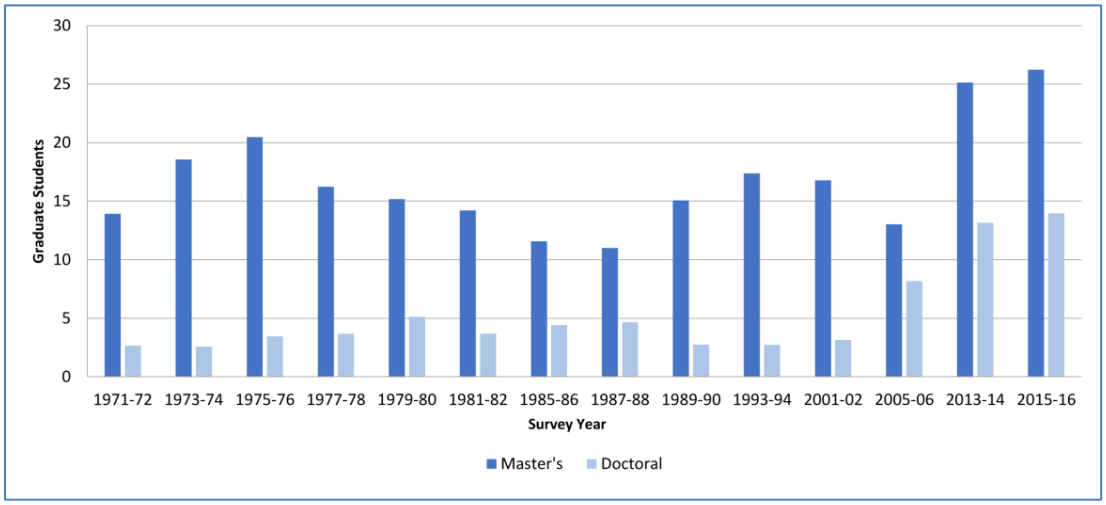
EXECUTIVE SUMMARY

This report provides insights into the status of power engineering education in the US and Canada for the 2015-2016 academic year. The report focuses on accredited engineering programs at universities that replied voluntarily to an online survey between July and December 2016. For the 137 universities (127 US, 10 Canadian) that submitted data on their electric power engineering programs, the report contains information on faculty and staff providing instruction, student enrollments and degrees granted, course offerings and enrollments, and research areas and funding levels. Analyses incorporate the results of fifteen prior university surveys of power engineering education resources since 1969-1970. The results show substantial growth in student interest, and in the number of faculty and staff providing instruction. Course subjects are also evolving in response to the changing education needs of the next generation of power engineers.

Degree Offerings: Undergraduate engineering degrees were offered by all of the responding universities, and the students can take mandatory and elective power engineering courses to prepare for power engineering careers. Some universities let undergraduate students select a power engineering specialty, such as by providing track or certificate options. All Canadian universities offered master's and doctoral degrees while about 88% and 75% respectively of the US universities did. Online graduate degree opportunities, most often for master's degrees, were reported at a number of universities. Most universities encouraged coop experiences for undergraduates.

Student Enrollments and Degrees Granted: Student interest in power engineering careers has grown substantially. Graduate student enrollments are shown in the chart below. In the US, there has been about a doubling of master's, international, and full-time students between the 2005-6 and 2015-16 academic years. In 2015-16, international students were about 78% and 73% of full-time doctoral students in the US and Canada respectively. Domestic students had the highest percentage of part-time students, reaching 80% and 91% of master's students in the US and Canada respectively. Many part-time students were likely pursuing an advanced degree while working. Although most graduate students were international, a little over 80% of undergraduate students were domestic.



Average Number of Graduate Students Enrolled in Universities Reporting Non-Zero Enrollments

The following table gives the Survey Team's estimates of the number of degrees granted in 2015-16.

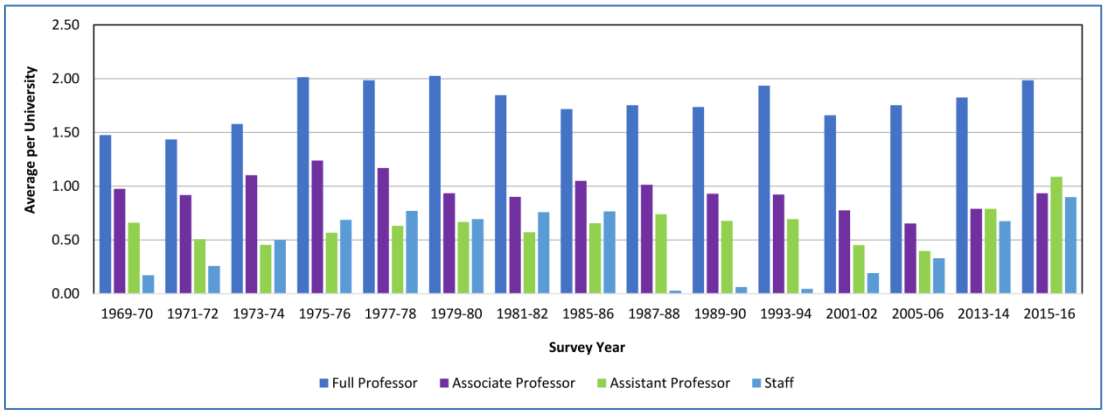
ESTIMATED DEGREES GRANTED IN THE 2015-16 ACADEMIC YEAR

Category	Canada	US
Undergraduates	420	2,889
Master's	184	1,362
Doctoral	91	365

As mentioned above, a little over 80% of the undergraduates were domestic students. The Survey Team found that between 2013-14 and 2015-16, the number of degrees granted to undergraduate and graduate students grew in the US and Canada. However, for universities responding to both surveys, enrollments of domestic master's students declined and enrollments by domestic doctoral students were about the same.

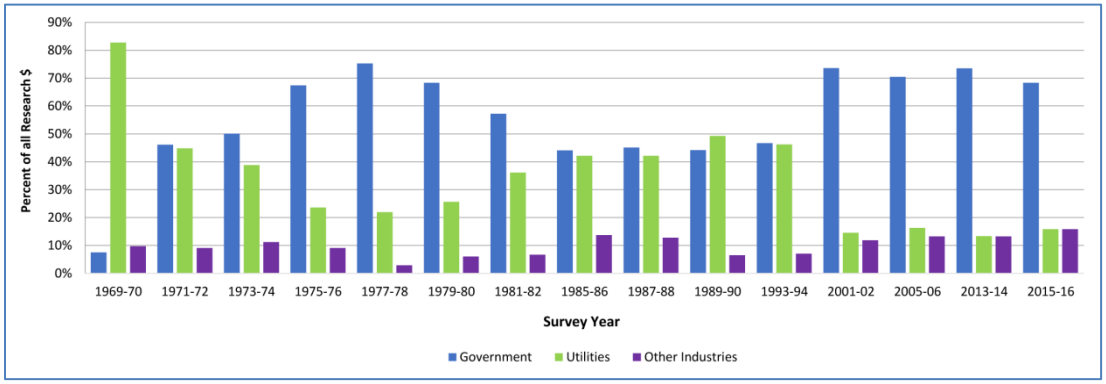
Courses: Over 1,500 undergraduate and graduate courses were reported. Power and energy systems courses were frequently identified, but the universities were also offering courses in various new technology subjects, particularly courses related to power electronics and renewable generation. Distance education enrollments in one or more undergraduate and/or graduate courses were reported by 18% and 32% of universities respectively.

Instructional Faculty and Staff: As shown in the chart below, the number of instructional faculty and staff has been growing steadily since the 2005-6 survey. The higher number of young faculty members bodes well for the sustainability of university power programs as the universities prepare for senior faculty retirements. Almost 40% of faculty and staff were reported to be eligible for retirement by 2026. Universities have also increased their use of staff members, such as adjunct professors, instructors, and lecturers, probably to meet increased student enrollments while bringing engineers with industry experience in new technologies to the classroom. Most faculty and staff were in electrical and computer engineering, but the breadth of power engineering education has expanded with the use of faculty and staff in new disciplines for power engineering education.



Average Number of Faculty and Staff per University

Research Activities and Funding: Inflation-adjusted research expenditures increased by some 75% between the 2001-2 and 2015-16 surveys. Government funding played a central role in that expansion, as shown in the chart below. The two most frequently reported university research areas were intelligent grid and renewable generation. The growth in research funding has been essential to creatively addressing the challenges of new technologies and to supporting the faculty who met the substantial rise in the number of students taking power engineering courses.



Funding from Government, Utilities, and Other Industries (%)

Challenges: The survey results suggest that three key challenges in university power engineering education are:

- Motivating domestic students to pursue graduate degrees with a focus on power engineering
- Evolving curricula to address the challenges and changes facing the evolving electric power industry
- Maintaining sufficient research funding needed to sustain innovation to advance electric power and energy technologies, and to support young faculty members who will eventually replace retiring faculty.