Curriculum Innovation Driven by Industry Input

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Introduction

Curriculum innovation driven by industry input is very important to keep engineering and engineering technology courses up to date and state of the art. Here are given several examples of what educational institutions are doing to address this. Improving engineering management graduate student success through advisory board partnerships is happening at Middle Tennessee State University. A real introduction to and exploration of Euler’s symbol $i$ is being taught at Vaughn College of Technology. Curriculum innovation driven by industry inputs is taking place at the Metropolitan State University of Denver for both four-year degrees and certificates. Adopting the Cadence® Design System for an engineering technology program is being done at the University of New Hampshire, and building a better engineering technology graduate is the goal at Indiana University-Purdue University at Indianapolis.

Improving Engineering Management Graduate Student Success through Advisory Board Partnerships

The Engineering Management concentration of the Master of Science in Professional Science (MSPS) degree program at Middle Tennessee State University (MTSU) was designed to provide Middle Tennessee’s booming manufacturing industry with skilled graduates trained in engineering methodologies—including PMI Project Management, Six Sigma, and lean manufacturing—and in business management. Students in this program learn business and engineering skills in the classroom, then apply them in the field through class projects and a complex capstone internship, which takes the place of a traditional thesis. Thus, the Engineering Management program requires strong industry partnerships for the education and graduation of its students. The MSPS Advisory Board, which consists of local industry leaders and program alumni, acts to grow and maintain these critical industry partnerships. The Advisory Board’s role is 1) to ensure that the curricula stays leading-edge and covers the needs of regional employers and 2) to provide the class-projects and internships required for the students’ successful careers. By leveraging the experience and knowledge of the board, the program has been able to expand the opportunities for internships for its students and for industry collaborations with its faculty. Here is discussed the roles of the Engineering Management internship class and of the Advisory Board in improving student success, particularly in internship and job placement.¹

A Real Introduction to and Exploration of Euler’s Symbol $i$

In elementary schools the students are taught that negative numbers do not have square roots. The appearance of a square root of negative number in the course of a computation indicates that
either the problem has no solution or an error has occurred. Subsequently these students are told that negative numbers have “imaginary” square roots constructed with the symbol $i$ which represents the square root of $-1$. Additionally students are informed that appending the symbol $i$ to the system of “real” numbers enable all algebraic equations to have solutions, the truth of which is undeniable. However, this reasoning appears logically inconsistent. There is nothing imaginary about the symbol $i$ and its use. Here the following interesting topics in complex variable theory are discussed: 1) A sensible introduction to Euler’s $i$ which conforms to the way the symbol is used in analyzing alternating current circuits and mechanically vibrating systems, 2) The description of the relationship of complex phasors to combinations of sinusoidal oscillations which underlies the theory of alternating current analysis promoted by C. P. Steinmetz, 3) The description of a system of real number entry 2X2 matrices which can represent complex numbers, 4) The meaning of the derivative of a function of a complex variable and a geometric interpretation of the Cauchy-Reimann equations. Here will be provided a solid introduction to students interested in AC analysis and vibration theory and encourage their further study of the theory of complex variables.2

Curriculum Innovation Driven by Industry Inputs: Four-year Degrees and Certificates

In the past few years the Metropolitan State University of Denver has experienced some curricula changes either driven or impacted by industry inputs. These changes may be creations of certificates or undergraduate majors. Here is presented the case studies in creation of three academic programs. In 2016 a group of Colorado construction companies led by the Rocky Mountain Chapter of the Associated Builders and Contractors and the Associated General Contractors of Colorado approached MSU Denver discussing the possibility of creating a new academic major in construction project management. Although construction industry is booming in Colorado, the school wanted to make sure that four-year degree graduates are needed and, if so, what subjects are preferred in composing the curriculum. A major was created in construction project management (CPM) with two concentrations based upon the survey results. The program was approved by CDHE in the summer 2016 and officially launched in the fall of 2016. Currently there are over one hundred declared majors. In the fall of 2017, representatives from the Facility Management Accreditation Commission (FMAC) and the international facility management association (IFMA) Foundation contacted the school to discuss the possibility of the creation of facility management programs. IFMA Accreditation and Academic Affairs provided the school with core competencies as a guideline for the curriculum creation. The facility management program will be added to CPM as the third concentration. Some of the immediate demand from the industry may not require a full four-year degree. A certificate program will be a great answer to such demand. The certificate in engineering manufacturing was created in response to the need of the manufacturing industry due to the labor shortage in Colorado. The certificate was initially proposed by Denver local companies, Mikron, Intertech Plastics, and Andrew. With the certificate a student should be able to start his or her career in mechanical or industrial engineering technician positions with a chance to move into quality assurance expert jobs or become lean manufacturing specialists. Also, since all of required courses can be applied to the manufacturing concentration of mechanical engineering technology (MET), a student can come back to MSU Denver to pursue a BS degree in MET in the future. From the school’s experience, a four-degree driven by the industry will be a multidisciplinary degree from traditional academic
points of view. There is usually no need or minimal requirement in creating new courses if academic departments work collaboratively.³

**Adopting the Cadence® Design System for an Engineering Technology Program**

The University of New Hampshire (UNH) offers a four year program in Electrical Engineering Technology (EET). This work describes a multi-year collaboration between the UNH-EET program and an industry partner to develop a digital and analog curriculum to address the staffing needs of the regional microelectronics industry. The UNH-EET program consists of a three course sequence in digital and a two course sequence in analog. The introduction course topics are consistent with traditional analog and digital EET curriculum with the advanced courses now covering integrated microelectronics concepts. The advanced digital course covers Metal Oxide Semiconductor (MOS) transistor theory, Complimentary MOS (CMOS) processing, transistor level gate delay analysis, power estimates, interconnects impact assessment, reliability design considerations, CMOS scaling calculations, and system simulation approaches. The advanced analog course includes transistor amplifiers theory, design of transistor level differential amplifiers, multistage amplifiers applications, implementation of bias circuitry, and output stage architecture. Through a partnership and financial support of a major international semiconductor company, the industry standard Electronic Design Automation (EDA) Cadence® Design system has been adopted for the associated laboratory exercises on schematic capture, simulation and physical design for both the digital and analog curriculum. Over a four year period enrollments in the course sequence has increased and steady placement of students in the microelectronic industry for the region has been demonstrated. This curriculum approach makes the UNH-EET program one of only 250 American academic institutions to provide access to the Cadence Systems through the Cadence® University Program.⁴

**Building a Better Engineering Technology Graduate**

Advances in technology applied in industry have resulted in a transformation of the manufacturing environment from one of large numbers of people doing mostly physical tasks to one in which a reduced workforce is used to support automated machinery and systems. The supply of adequately trained engineering technology graduates is far below the need for them resulting in increasingly high numbers of unfilled jobs annually. This is compounded by the fact that the technology itself is constantly changing and evolving, making the desired skillset one that is in constant flux. To meet these needs academia and industry have to develop close partnerships to shape the curriculum to be up to date and relevant. This includes the need from industry to help from an advisory position, with funding for frequent lab equipment upgrades and training, and internships. Academia has the responsibility to stay current with the technologies that are being employed by their industry partners much in the same way as the engineers working for those companies must stay current to be effective. The result of this partnership will produce a more work ready job candidate who will require less time and resources to get assimilated into the work flow and start contributing as a functioning member of the organization.⁵

**Bibliography**

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