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- Sebastian A. Maurice and Robert L. Day** 152–160 Online Testing Technology: Important Lessons Learned
- We report results on how design aspects of technology and perceptions of students towards online testing technology affect the learning and preparation process of students. Using data from a survey of 285 university students, we present their feedback on whether online testing was an effective tool in helping them learn the course material and a good preparation for in-class exams. The lessons we learned may be helpful to others who plan to implement, or develop, similar technology in their classroom. Our results are not surprising, but offer further insight into the learning process of students and how this is affected by technology. The results provide a basis for further study into other areas of online testing such as: cheating by students and how this can undermine learning and understanding of course material; security issues as they relate to test questions; and how perceptions towards technology affect learning. Our results also reinforce the view that technology design, ease of use, functionality and accessibility must be given high priority by administrators and developers because these factors can influence the learning, and preparation, process of students. Ignoring these factors can lead to extremely unhappy students who expect to learn without being inhibited by technology.*
- Stephan Hussmann, Grant Covic and Nitish Patel** 161–169 Effective Teaching and Learning in Engineering Education using a Novel Web-based Tutorial and Assessment Tool for Advanced Electronics
- This paper presents experiences using a novel Web-based tool called OASIS (Online ASessment and Integrated Study), in the teaching of a Part 3 course in the Department of Electrical and Electronic Engineering at the University of Auckland. OASIS was employed for formative and summative assessment. The difficulties faced in introducing this new tool in an advanced engineering course and the advantages sought in doing so are discussed in this paper. The experience was evaluated over two academic years from both the instructors' and the students' points of view and found to be well received and beneficial to both parties. Principal benefits include reduced instructor marking workload and improved educational learning outcomes for students.*
- A. Almendra, F. J. Jiménez-Leube, C. González and J. Sanz-Maudes** 170–175 An Experience De-localizing a Freshman Electrical Engineering Laboratory
- A summary of the activities done by the authors in order to evaluate the feasibility of the extension to de-localized teaching of experimental matters using the Internet is presented and discussed. We have considered a basic configuration: students that do their practical work at a remote bench authenticated by a laboratory server. The existence of remote benches requires us to contemplate problems related to some kind of real time supervision and validation of the work done at the remote site as well as with the communications that are necessary to demand and deliver remote assistance. These issues are usually addressed 'in-situ' in a local lab. The work at the bench is done under the immediate supervision of a local computer that also sends information to the server about the progress of the assigned work, and that is also able to communicate with an instructor using different tools developed during this work. These isolated remote benches could be aggregated to form a remote laboratory or, in general, a virtual laboratory under centralized supervision; the activity carried out at each remote bench is monitored without the need of intervention of the student. The target we had in mind when we began the experience was to evaluate the possibility of sharing expensive resources between different users. Our conclusions and suggestions are finally stated.*
- Steve E. Watkins, Richard H. Hall, K. Chandrashekhara and Julie M. Baker** 176–187 Interdisciplinary Learning through a Connected Classroom
- An interdisciplinary course is described whose learning objectives were to build foundational knowledge, collaborative skills, and functional knowledge in an advanced technical area. The 'connected-classroom' instructional design stressed active, collaborative learning through a structured combination of World-Wide-Web-based tutorials, lecture supplemented with Socratic dialogue, role-based group assignments, and applied laboratories. A characteristic that makes interdisciplinary courses difficult, namely the mixed student backgrounds, was used to guide collaborative activities and to promote an interconnected view of concepts. Over three semesters, the course format and components were implemented, assessed, and revised based on the assessments. Learning effectiveness was strongly influenced by the course components that addressed disparities in student background and that linked foundational concepts to applications. Senior undergraduates and graduate students from electrical engineering, computer engineering, mechanical engineering, aerospace engineering, and civil engineering participated. The topical area was composite materials and sensor systems for smart structures.*
- M. J. Moure, M. D. Valdés, A. Salaverria and E. Mandado** 188–192 Virtual Laboratory as a Tool to Improve the Effectiveness of Actual Laboratories
- This article describes a virtual laboratory as a tool specially intended to improve the students skills before going to the actual laboratory. To accomplish this objective the system also provides a set of complementary resources, constituting a bridge between theory and practice. This new kind of virtual laboratory takes advantage of the information technologies (multimedia, simulation, etc.) and also facilitates the self-assessment of the students' knowledge.*

An open-ended laboratory experiment program with computer-aided simulation has been successfully operated for undergraduate electronic engineering course over ten years. Such an innovative exercise gives students the feeling of a design environment for the real industry outside the academic world. It also encourages students using their individual creativity to learn about a particular electronic component or system in great detail.

An undergraduate course in Communication Theory, aimed at Spanish Telecommunication Engineering students, has been augmented with various experiments introduced to enrich the student's understanding on basic topics such as linear and angular modulations, random signals and noise. The equipment required is minimum and inexpensive. In fact, the equipment already available in lab benches of an Electronic Instrumentation course has been used with some additional inexpensive, off-the-shelf electronics. The full exploitation of the potentials of the existing instruments and their PC connectivity made additional investment unnecessary.

This paper describes a case study for using a well-defined research problem in a final-year undergraduate project. While putting extra organizational efforts on the faculty member, several goals are achieved among which: pushing the wheel forward in an ongoing research activity and refreshing it with new visions, giving some students more space for creative thinking and discovering their tendency to postgraduate studies, and enforcing university–industry cooperation. In the second half of the paper, students give their feedback and describe the whole experience from their own perspectives.

The comparison of four control schemes based on neural networks for teaching purposes is studied in this paper. The inverse model, inverse model loop, direct scheme with and without models are investigated and compared. The study is based on computer simulations of linear and nonlinear single-input single-output (SISO) typical plants and take into account different aspects such as the training period, the training method (on-line, off-line, simple or with epochs, etc.) network configuration and training signals amongst others. This set of experiences can be used in an advanced control course in the Electrical Engineering curricula, to teach different aspects of neural control.

In this paper, an educational tool was presented to supplement existing undergraduate and graduate electrical machinery laboratory instruction, so that students could establish a thorough understanding of a fuzzy logic controller (FLC) and an indirect vector control induction motor (IM) drive using the FLC. The tool describes the basic operation of the indirect vector controlled IM drive and, application of fuzzy logic speed control to the vector controlled IM. The FLC was applied to the speed loop, replacing the conventional PI controllers. The educational tool allowed the student to interact with the indirect vector controlled IM drive using the FLC and to examine its responses on a dynamic and instantaneous basis under different operating conditions.

Mechatronics design provides an excellent project-based learning activity in engineering education. It weaves together the Computer, Mechanics, and Electrical Engineering Curriculums, forming one of the key issues in all of them. This paper proposes a design method for control of a robot that can be used as a core part of a mechatronics course. This method includes: a) a universal formal notation including the concepts of ASM (Algorithmic State Machine) and FSM (Finite State Machine), as a basic aspect of designing a mechatronics control system, and b) an interactive learning environment developed on the basis of the formal notation. In this paper, both of the above components are presented in the context of a specific mechatronics design course based on a mobile robot contest. The proposed approach a) decreases the gap between theoretical and practical skills of students in mechatronics thus leading to a better robot design with a better contest-related performance; b) improves the real robot performance; and c) opens up a way to enrich mechatronics lessons by increasing the number of possible tasks and projects in a class.

Studying engineering has become less attractive to high school students in Slovenia since the beginning of the 1990s. Faculties of electrical, computer, mechanical and civil engineering faced a drop in the number and/or quality of freshmen students. At the Faculty of Education, University of Ljubljana, we considered that the knowledge and skills of middle and high school teachers of science and technology might contribute to change these trends. To this end, an existing course in electronics for pre-service teachers was modified to emphasize project-based work, integration of science and engineering disciplines, implementation of data acquisition systems, introduction of state-of-the-art topics, etc. The course structure and examples of students' projects are outlined in the paper.

Part 2

Contributions on Communication Skills, Innovation and Creativity, Software Engineering, Engineering Management, Control Engineering and Chemical Engineering

This article begins with an outline of the basic skills and knowledge students must acquire to write effectively. It then examines the concept of learning to learn and presents methods for teaching students how to transfer the skills and knowledge they learn from one assignment to the next, from one course to the next. Although this article focuses on the transfer of learning in technical communication, the methods can be used in engineering as well. It explains how we can help students learn to learn by teaching them to transfer knowledge through metacognition, analogical reasoning and cognitive flexibility. The article concludes with an example of a sequence of technical communication assignments that lead toward transference regardless of whether they are being taught in a standalone communication course or as part of an engineering class.

Engineering students are crammed with technical knowledge while learning at university. Students are always interested primarily in technical subjects, whether they are good at them or not. Most teaching programs constantly try to inject more and more specialist knowledge and skills into the young brains of the students. If these young engineering students are not innovative and creative at university, how can we expect them to behave so as engineers in society? How can such an ambition be achieved without the corresponding and indispensable support from our local universities, and primary and secondary schools? This is exactly the sort of problem that this paper aims to address—to teach engineering students to become professional engineers with society in mind, and with creative and innovative flair. This paper highlights the concepts of innovative and creative design, and aims to demonstrate that creativity, innovation, techno-economics, quality, social impact, and professional ethics can be taught and experienced at the same time, thus reinforcing that they are all linked together.

Daniela Rosca, William Tepfenhart and James McDonald 267–276 Necessary Metamorphoses of a Software Engineering Program

We present the main lessons learned over the 16 years we have been running a graduate degree in software engineering at Monmouth University. It covers the challenges in delivering a program that meets the needs of industry and students in a highly dynamic field. The evolution of the curriculum induced by the domain's continuous advances and industry practice is presented. This evolution is an example of a transition from a 'computer science curriculum with an engineering flavor' towards a software engineering curriculum. The special meaning of continuous course content development in software engineering is argued through issues pertaining to dated textbooks and ever-changing programming languages, operating systems, and software tools. The paper also presents our experience of dealing with the diversity of the student body, and its influence on the curriculum and course content. The paper concludes with recommendations for constructing a similar program and ideas for future developments.

Terry R. Collins and Alisha D. Youngblood 277–285 Envisioning Change and Revitalization for a University Engineering Management Program

The University of Arkansas is restructuring the Master's of Science degree in Engineering Management offered within the Industrial Engineering department. A comparison study and market survey are used to identify critical characteristics of an Engineering Management (EM) program. The comparison study analyzes 17 graduate EM programs from across the United States to discern consistencies in core courses, degree hour requirements, program course content, and availability of degree program to off-campus students. The market study survey is administered to determine the critical mass for an EM program, and recognizes potentially significant sources of student populations based on local, regional and national markets.

Michael Reynolds, Peter H. Meckl and Bin Yao 286–292 The Educational Impact of Modular, Open-ended Controller Design Projects

In the fall of 2001 we implemented the first of a series of new controller design projects in our Junior/Senior level controls class in Mechanical Engineering at Purdue University. Our first new project was the design of a controller for the point-to-point motion of a gantry crane. Student teams modeled the gantry crane and developed a controller to meet performance specifications. The equipment was used for different projects in subsequent semesters. At the end of each semester, each group presented their design and students stayed voluntarily and asked questions for several hours. We have been very impressed with the quality of the students' work. We believe that the combination of hands-on equipment, the challenge of the project specifications, and a design competition greatly motivated our students. The purpose of this paper is to describe the changes we have made to our projects and what we have learned from the process.

Jianzhong Wu 293–301 Integrating Novel Examples into Thermodynamics Courses

The study of thermodynamics began around the 1820s, stimulated by the practical concerns of improving the efficiency of steam engines. While the principles underlying the conversion of thermal energy to mechanical work are now well established, thermodynamic laws have been applied to interpreting many other natural phenomena ranging from everyday life to cosmology. For contemporary chemical engineering, applications of thermodynamics are not limited to energy balances in flow processes, production of power from heat, or phase-equilibrium calculations for the design of efficient separation processes, as introduced in a typical undergraduate textbook or as encountered in the traditional chemical and petroleum industries. Today, assisted by statistical physics and molecular simulations, thermodynamics remains useful in numerous emerging areas of chemical engineering. To illustrate, this article provides three examples: application of thermodynamics in environmental protection, in the fabrication of nanostructured materials, and in the specification of conditions for protein crystallization. While these applications are significantly different from those introduced in standard undergraduate thermodynamics courses, the thermodynamic principles needed for the development of today's novel technologies are essentially the same as those used for the design of efficient heat engines.