

The International Journal of Engineering Education

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Engineering Education Policy and Research
- J. E. Holt** 256–263 Practising Practice by Design
There is a compelling case for cultural change in the engineering profession if it is to continue to have an important and central role in the technological world it has helped create. Such a change must begin in the educational experiences that shape and prepare students of engineering for professional practice. But any change to better equip graduates for practice has to recognise and address the reality that, at heart, the fundamental purposes of the academy and the profession-in-action are different. This paper proposes that studies in design are an effective and productive way of addressing this central dilemma in professional engineering education. It draws on reflected experience in teaching mechanical engineering design at the University of Queensland to set up a framework for learning design. It is argued that, in professional education, the academy must be committed to the requirements of life outside and that the disciplines informing the proper practices of academe and of the profession share a common purpose. Both enquiry and application are important in every activity of life. This paper, therefore, constructs a map of the relationship between practice as performance in academe and the profession. It transforms the map to apply specifically to design, defining two distinct but contiguous regions featuring problem-solving and problem-setting. A learning experience/time path is charted on this map to plot the directions a design-as-preparation journey needs to follow. At each phase of this journey, the general approaches adopted at the University of Queensland are related. The paper concludes with reflections on some recently graduated students as they end one journey and prepare to start another.
- Norene Moskalski** 264–274 Factors that Enhance or Constrain Implementation of Team Activities in Engineering Courses
The Accreditation Board for Engineering and Technology in the United States strongly recommends that engineering schools add project-based team learning to the engineering curriculum. This research study provides Deans and Department Heads with information about what enhances or constrains faculty members' willingness and ability to implement team activities in their classes. Results from a grounded theory qualitative analysis and multiple logistic regression analyses confirmed that previous experience with team activities, whether successful or unsuccessful, previous training on team activities and time constraints, were all significantly related to the use of team activities by these research university professors.
- L. A. Van Dijk and W. M. G. Jochems** 275–284 Changing a Traditional Lecturing Approach into an Interactive Approach: Effects of Interrupting the Monologue in Lectures
A study of the effect of interactive instruction in lectures on student results, study behaviour and student motivation is presented. The study indicates that changing a traditional teaching approach in lectures into an interactive lecturing approach is feasible. Such an interactive approach was shown to positively influence student motivation. Students' increased motivation seemed, however, restricted to the classroom, as only weak effects on students' self study were found. Student results increased when lecturers involved their students more in their lectures. It can be concluded that changing a traditional approach in lectures towards a more interactive approach can be considered beneficial to the students.
- Stanislav Karapetrovic** 285–294 Why and How to Develop a Meaningful Quality Assurance System in Engineering Schools
National accreditation of engineering undergraduate programs is probably the most common quality assurance scheme used in universities today. However, calls are increasingly being made to expand the scope of formal quality assurance systems into graduate education and research, and to provide an international accreditation framework. The new ISO 9000 (2000) standards have the capability to address these issues. This paper discusses the reasons for the implementation of the flagship standard in the series, namely ISO 9001 (2000), as well as methods for the development of a quality system in engineering education and research. In addition, approaches to monitoring the quality of teaching and learning outcomes are presented.
- Amin Elshorbagy and Dieter J. Schönwetter** 295–300 Engineer Morphing: Bridging the Gap Between Classroom Teaching and the Engineering Profession
Teaching engineering is a highly significant task. Engineering is not a self-taught discipline; it requires supervision, guidance, and instruction. This paper discusses some of the main features of current engineering education in many institutions and its challenges. A number of suggestions are provided to enhance the engineering education process. These include the importance of teaching communication skills, broadening the students' perspective with the ethical issues of engineering, and implementing the inductive instruction technique as an effective approach for teaching engineering. Suggestions are also given regarding assessment of the performance of engineering students.
- Joshua C. Harrison** 301–306 On Scope and Assessment in Modern Engineering Education
As the field of engineering incorporates new technologies, the appropriate scope of undergraduate education in engineering continues to grow. It appears unlikely that course breadth can be widened to accommodate this growth, at every institution, by increasing the length of the undergraduate engineering curriculum. Therefore, with increases in breadth must come sacrifices in depth of coverage for many subjects. This paper explores the tradeoffs associated with engineering course scope, and discusses the possible remedies to engineering course overloading. Choices made regarding scope of the engineering course can affect, and be affected by, the methods used to assess student performance. But, as with course scope, any choice made between assessment methods is also fraught with tradeoffs. Conclusions are drawn and recommendations are made, based on a solicitation and analysis of mechanical engineering student and academic staff opinion on course scope and assessment.

The organisational culture of the student body has a powerful influence upon the quality of undergraduate education. Furthermore, the importance of cultivating an appropriate organisational culture amongst the student body is certain to increase. This will occur naturally as university departments introduce more 'student directed learning initiatives' with on-line components and assessments, amalgamate subject offerings and reduce academic staff numbers. This paper discusses the importance of the organisational culture of the student body in a relationship marketing framework, then describes a vertically integrated design and build project specifically targeting organisational culture amongst Mechanical Engineering students.

S. K. Stoll, K. A. Prisbrey and F. H. (Sam) Froes

315–320 Advanced Materials—Any Ethical Questions? Study

This paper describes how three professors from diverse academic fields—sports, ethics and metallurgical engineering—came together to teach a class in ethics, competition, and advanced materials technology. The dual focus of the course was: (1) on the growth of technological advances in sport equipment design, and (2) on the ethical questions that could and should be asked when such advanced designs alter what is generally human practice. Class enrollment was 21 college age junior science majors.

Stuart Palmer

321–330 An Evaluation of Undergraduate Engineering Management Studies

In 1996, a major review of engineering education in Australia recommended a move from a course accreditation regime based on prescribed inputs to demonstrated graduate attributes. In the move, the policy on management studies in engineering undergraduate courses has become less definitive and more open to interpretation. A survey of recent engineering graduates suggests that those management skills most highly valued by graduates were generic professional practice skills, and that more opportunities to develop these skills in undergraduate studies would be beneficial. Survey respondents suggested the inclusion in the course of more 'real world' examples of engineering management.

Information Technology

Ian J. Craddock, Gosia Mendrela and Julian Cook

331–336 Developing and Evaluating a Novel Technique for Recording and Asynchronous Delivery of Lectures

A novel and inexpensive technique for recording the handwritten, audio and video information in a lecture is described. The recording may be streamed to a standard, free, multimedia player over any Internet connection (from 56kbaud modem upwards). In being able to handle graphical and mathematical material this method is particularly suited to the delivery of engineering lectures to off-campus students. An evaluation of student impressions of the technique is presented, and conclusions are drawn.

Mechanical and Civil Engineering

G. Falsone

337–343 The Use of Generalised Functions in the Discontinuous Beam Bending Differential Equations

This paper discusses materials for a course in Strength of Materials and Mechanics of Solids, addressed to students of second-year Mechanical Engineering, Ocean Engineering, Civil Engineering and Aerospace Engineering. In particular, the presence of discontinuities in the beam-bending differential equations is considered. This problem is solved by the use of the generalised functions, among which the best known is the Dirac delta function. In particular Macaulay's approach, which uses these functions when discontinuous mechanical loads are present, is here extended to the cases in which discontinuous external loads are present, giving discontinuities on displacements and rotations. Moreover, the cases in which natural and essential constraints are along the beam axis, giving different kinds of discontinuities, are presented. This extension shows the same easy applicability and the same practical advantages of the Macaulay's approach, always reducing to one the differential equations to be solved in order to find the displacements law. Moreover the formulation is given in a uniform way for any kind of discontinuity appearing in the beam. The mode of presentation of this material is by lecture and is run as a regular course. Hours required to cover the arguments are 3 to 4 with 2 to 3 revision hours. This lecture must be held after that the classical beam bending problem has been treated. The new aspects presented in this paper hopefully help the students to find important connections between some aspects of mathematician analysis and an important problem of applied mechanics.

Electrical Engineering

Jawad Faiz and M. Ojaghi

344–356 Instructive Review of Computation of Electric Fields using Different Numerical Techniques

There are different numerical techniques for computing electric fields. These numerical techniques enable the designer to study the problems that are difficult to be solved by analytical methods. This paper attempts to give an instructive review of different numerical techniques in electric field analysis. These techniques involve finite difference, finite element, boundary element, charge simulation, finite element with variable field intensity and Monte Carlo methods. The merits and limits of the various methods are outlined. Some examples are given in which the field computations using different numerical techniques are compared. As an example the most convenient technique applicable to electric field computation within the tank of power transformers is introduced.

Industrial Engineering

François Gauthier and René Benoît

357–368 Design-for-Safety Competencies for Automated-System Design Engineers: A Case Study

Since the 1960s, the use of programmable technologies has been constantly evolving in all facets of paper production. However, production system automation is responsible for a certain number of serious accidents. This article first presents the current situation in design practices for automated facilities, based on data collected in twelve paper mills from semi-structured interviews and focus groups. Eight competencies that design engineers in large processing industries should have so that they can better apply worker safety considerations when designing automated systems are then presented. These competencies were the basis for an extensive training program for automated-system design engineers.

Chemical and Process Engineering

Jane P. Chang

369–378 A New Undergraduate Semiconductor Manufacturing Option in the Chemical Engineering Curriculum

The engineering curriculum reform in the 21st century should focus on providing students with a broad knowledge base and crosscutting programs in interdisciplinary fields including semiconductor manufacturing and nanotechnology. The traditional engineering education training is often inadequate in preparing the students for the challenges presented by this industry's dynamic environment, and insufficient to meet the employer's criteria in hiring new engineers. This paper describes a new multidisciplinary curriculum and training program at UCLA. The program provides knowledge and skills in semiconductor manufacturing through a series of courses that emphasize on the application of fundamental engineering disciplines in solid-state physics, materials science of semiconductors, and chemical processing. This new curriculum was recently accredited by the Accreditation Board for Engineering and Technology (ABET).

It is possible for any 16+ or undergraduate student to construct an aluminium-air battery relatively easily and safely. This system makes only minimal demands on materials and financial resources but offers the potential for a comprehensive, hands-on characterisation of a modern electrochemical cell. This paper describes an experimental program and presents typical results. Investigations include measurement of anode, cathode and cell potentials and current together with an examination of the influence of electrolyte concentration. The paper also examines the effect of air-sparging at the cathode.