

# The International Journal of Engineering Education

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- Starting with multimedia learning modules for statics, and drawing on the rich literature on learning and teaching, we developed a learning environment that includes the following features: statics integrated with mechanics of materials, physical models, interactive multimedia, traditional pencil-and-paper activities, and cooperative learning in the framework of experiential learning. Our laboratory for evaluating and improving this learning environment is a course taught to students in architecture. In this paper we describe the learning environment and illustrate how students are guided to develop the concepts of moment and bending moment, the condition of moment equilibrium, and a procedure to construct shear and moment diagrams.*
- Francesco Costanzo and Gary L. Gray** 385–393 On the Implementation of Interactive Dynamics
- A new project for the enhancement of undergraduate engineering courses via the use of computers in the classroom is being developed at Penn State University. This project involves the introduction of simulation, experiment, and teamwork in courses traditionally containing neither. We briefly describe our approach and detail some of the important issues and hurdles that we have encountered during its implementation. It is our purpose that this information will assist other educators in implementing the Interactive Mechanics concept or learning environments like it.*
- George Staab and Brian Harper** 394–400 Use of Computers in Mechanics Education at Ohio State University
- Computers offer opportunities for enhancing undergraduate mechanics instruction. Two approaches utilizing computers in undergraduate mechanics courses at the Ohio State University are presented herein. One approach focuses on requiring students to formulate the equations that define general solutions to classical mechanics problems with variable parameters. Computers are used to solve these equations and plot the results. Students evaluate their results and answer questions based on their solutions. The second use of computers involves mechanics tutorials developed at Ohio State for strength of materials. Tutorials contain theory, examples, and quizzes for students to attempt. Both approaches appear to complement traditional in-class instructional approaches.*
- Timothy A. Philpot** 401–407 MDSolids: Software to Bridge the Gap Between Lectures and Homework in Mechanics of Materials
- Current educational software for the mechanics of materials course is typically presented as tutorials, worksheets, or basic analysis packages. A new software package, called MDSolids, presents an alternative to these types of products. MDSolids is conceived as a tool to help students solve and understand homework problems typically used in the mechanics of materials course. The software is versatile, graphic, informative, and very easy to use. MDSolids is being used at a number of schools around the world, and feedback from users has been uniformly positive and enthusiastic.*
- Mehrdad Negahban** 408–416 Results of Implementing a Computer-based Mechanics Readiness Program in Statics
- We have developed and implemented a computer-based Mechanics Readiness Program based on the ASEE Mechanics Readiness Test. Our interactive testing and instruction system was developed for use during the first week of our sophomore statics courses. The intent of this program is to help students rapidly review prerequisite materials, primarily from mathematics. The program can be reviewed at <http://lem-ntserver.unl.edu>. The results of our study indicate that the test scores have a weak correlation with the final course grade in statics, even though a low test score is a strong indication that the student will not complete the course. A description of the program and our initial results are provided here.*
- Iheanyi E. Eronini** 417–422 Multiple-Feature/Multidisciplinary Design Project in an Introductory Engineering Mechanics Course
- A simple truss bridge design project for a one-semester sophomore-level combined course in statics and dynamics, taken by a multidisciplinary class of students from civil, electrical, and industrial engineering at Morgan State University (MSU), is described. Patterned after a continuing and popular annual Student Steel Bridge Design/Building Competition, the design project problem statement incorporates conflicting constraints and simple scoring or objective formulas. As a result the design problem is open-ended; however, an added benefit is that the same basic project can be repeated in successive classes due to the manner in which the constraints are prescribed. Class members who participate in the MSU Steel Bridge Team also get to experience more detailed design iteration, realization of the eventual bridge design, testing of the product and even validation of the bridge's performance in the corresponding year's Student Steel Bridge Competition (SSBC). Preliminary results from the first two semesters of introducing the project suggest some improvement in student performance and learning in the engineering mechanics course. As a sophomore level course, the design project also contributes to the integration of design across the engineering curriculum at MSU.*
- N. J. Salamon and R. S. Engel** 423–429 A Management/Grading System for Teaching Design in Mechanics of Materials and Other Courses
- A plan for class management and grading in Mechanics of Materials with design is offered for two reasons: (1) Teaching design in a topic-packed analysis course like Mechanics of Materials places demands upon instructors beyond the traditional course and this paper offers suggestions on how to cope. (2) At Penn State, the Engineering Science and Mechanics Department traditionally seeks a degree of conformity between sections and offers a common final exam, hence there are some rules that instructors must follow to maintain this policy. The paper is the result of experience and treats methods for selecting teams, guiding students through learning the design process, structuring the design report and assigning grades to individuals within a team. The plan is aimed at effective, yet efficient teaching, is open to continuous improvement and applicable to other courses.*
- P. Chang and W. L. Fourney** 430–435 Design-Based Course Sequence in Statics and Strength of Materials
- We present in this paper an attempt to help students reach the ABET 2000 goals from the context of reforming two engineering courses: statics and strength of materials (mechanics of materials). In the traditional course of statics, students usually learn to obtain only the internal forces for trusses and beams. In the reformed curriculum students are asked to analyze and design a simple structure. Statics, presented in this context, is natural and easier to comprehend. In this approach the concept of stress is introduced early.*

*Strength of materials focuses on the determination of stress and deformation of transversely loaded structures and statically indeterminate structures. In this paper, we outline the topics covered in each of the two reformed courses compared to the traditional curriculum. We discuss the delivery of the design-based courses, and we show the student's and instructor's perspective of the changes.*

**L. Glenn Kraige and Don H. Morris** 436-440 Recent Curriculum Changes in Engineering Science and Mechanics at Virginia Polytechnic Institute and State University

*Within the last five years, the College of Engineering at Virginia Polytechnic Institute and State University (VPI&SU) has restructured the common freshman and sophomore curriculum. In addition, the Department of Engineering Science and Mechanics (ESM) has undertaken a complete overhaul of the ESM undergraduate degree. Coupled with these events have been necessary changes in service courses such as physics, an area which has a complex overlap with the basic engineering mechanics courses. The planning process for the new ESM curriculum is reviewed in this paper. Complete listings of both the old and new curricula are included.*

**Phillip J. Cornwell and Jerry M. Fine** 441-446 Mechanics in the Rose-Hulman Foundation Coalition Sophomore Curriculum

*Rose-Hulman Institute of Technology implemented a new sophomore curriculum starting in the 1995-96 academic year. The sophomore year curriculum primarily concentrates on engineering science material that is traditionally covered in courses such as Dynamics, Thermodynamics I, Fluid Mechanics, and Circuits I. At Rose-Hulman this material has been repackaged into a new sequence of courses where the concepts of conservation and accounting permeate the courses. The purpose of this paper is to discuss how the mechanics material has been distributed throughout the curriculum and how it is taught in the framework of conservation and accounting. Assessment results will also be presented.*

**M. B. Rubin and E. Altus** 447-456 An Alternative Method for Teaching Dynamics

*This paper describes an alternative method for teaching undergraduate dynamics that has been used in the Faculty of Mechanical Engineering at Technion for over twenty years. The sequence of topics in the course presents the kinematics of particles, systems of particles and rigid bodies in three dimensions before discussing the kinetics of these systems. This alternative sequence provides the students with sufficient time and practice to master the concepts of a rotating coordinate system which are essential for three-dimensional problems in dynamics. In addition, the paper presents a discussion of indicial notation and tensors, a simple proof of the formula relating the time derivative of rotating base vectors and the angular velocity vector, as well as a convenient tabular notation that helps formulate complicated problems in dynamics. Two example problems are presented to demonstrate the use of this tabular notation.*

**Kwabena A. Narh and Herli Surjanhata** 457-467 Innovations in Freshman Mechanical Engineering Curriculum at New Jersey Institute of Technology

*This paper describes the Mechanical Engineering contents of a new inter-disciplinary, project-based freshman engineering curriculum at New Jersey Institute of Technology (NJIT). The course, which was run as a pilot when this paper was written, is called Fundamentals of Engineering and has now been approved for the freshman engineering curriculum. The two case-study projects, which constitute the Mechanical Engineering component of the course curriculum, are the Lawn Sprinkler and 3.5-inch Floppy Disk Drive. In this course, the freshman engineering student is introduced to many aspects of engineering as an entire unit working together, with particular emphasis on the concept of teamwork in engineering research projects. Students are introduced to many computer-aided design tools available at NJIT which can be used not only to build models of the product to be manufactured but also for diagnostic analysis in order to solve potential manufacturing problems. The student is also introduced to the concept of communication among team members and the concept of technical report writing and oral presentation. The grading and course evaluation schemes are also discussed. A few samples of students' graphic communications are reproduced.*