Consider the following student experiences: … An engineering graduate student returns from a day of classes and reviews her notes. Suddenly she has a revelation—every one of her professors was talking about the same thing (although the names, symbols, and units were frequently changed to protect or confuse the innocent). Why had no one told her that engineering was really based on just a few recurring principles and concepts? … While trying to use energy to solve a problem, an undergraduate student asks, “Which energy equation should I use, the one from dynamics, the one from physics, the one from fluid mechanics, the one from heat transfer, the one from circuits, or the one from thermodynamics?” Or what about the senior student applying Newton’s laws who wonders, “Which free-body diagram should I use, the one from statics, dynamics, physics, or fluid mechanics?” What’s wrong with these students?

What would happen if the undergraduate curriculum was designed to show students the big picture and help make the connections that surprised the graduate student? What if the core courses were taught in a way that stressed the similarities instead of just the differences?

Beginning in 1995, Rose-Hulman Institute of Technology began teaching a new integrated engineering science core called the Sophomore Engineering Curriculum (SEC) that attempted to answer these questions. The SEC is based on a new paradigm for organizing an engineering curriculum—a system, accounting, and modeling approach—that emphasizes common, underlying concepts of engineering science. [With hindsight, these might be considered threshold concepts.]

The SEC presents six fundamental physical laws using a common system and accounting framework where each physical law is related to one extensive property—mass, charge, linear momentum, angular momentum, energy, and entropy. Building on this, the SEC also uses a common problem solving approach that emphasizes the use of first principles to construct problem-specific solutions with explicit modeling assumptions. By focusing on the underlying concepts and similarities between subjects that are often perceived by students (and taught by faculty) as unconnected topics, we believe this approach provides students a framework for building connections as they learn and for applying what they learn in new situations.

This seminar will discuss the system, accounting, and modeling approach as an organizing principle and the integrated curriculum that resulted from its application. Come join the discussion and see how these ideas might impact your courses and curriculum.

About the speaker

Prof Don Richards

is currently a faculty member at Rose-Hulman Institute of Technology in Terre Haute, Indiana, where he is a Professor of Mechanical Engineering and Director of the Center for the Practice and Scholarship of Education. All of his degrees are in mechanical engineering: B.S. – Kansas State University, M.S. – Iowa, Ph.D. – The Ohio State University. Prior to joining Rose-Hulman in 1988, he taught at The Ohio State University.

He has been involved in engineering education for almost 40 years and has taught a full range of courses in the thermal-fluids area. He has also done research and development work on natural convection heat transfer, augmentation of forced convection heat transfer, and heat exchanger design. His industrial experience includes two years in the commercial nuclear power industry working on high-temperature gas-cooled nuclear reactors.

Shortly after joining Rose-Hulman he and two col-leagues developed the Fluid Science Learning Center, an innovative hands-on laboratory that used a museum-like “water wall” and NeXT-based computer simulations to challenge student misconceptions about fluid mechanics. In 1993, he began working as team leader with a student and faculty group to develop, implement, and maintain the Rose-Hulman Sophomore Engineering Curriculum—an eight-course sequence of courses that provided an innovative, integrated treatment of basic engineering science and mathematics.

Dr. Richards is the co-author with Ken Wark, Jr. of Thermodynamics, 6th ed., published by McGraw-Hill in 1999. He also wrote the textbook Engineering Science—A Systems, Accounting, and Modeling Approach used in Conservation & Accounting Principles, the first course in the SEC.

Notes for participants

Numbers are limited, so please register your attendance to Erin Rummer (Email: erin.rummer@uwa.edu.au) by 24 July 2012.

Light lunch and refreshments will be provided.

Please provide a minimum of two days notice for cancellation.