118c Effective Integration of Coursework: Equilibrium Thermodynamics as a Bridge from Material and Energy Balances and Mass Transfer to Design

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A quick review of syllabi for a variety of engineering courses shows that instructors often do not use prerequisite materials effectively. All universities require some courses that are general in nature and cover core information like writing, mathematics, chemistry, and physics. From a student perception, they often feel that some of these classes are not directly related to their pursuit of an engineering degree. The same phenomena is true of our core courses where students will often compartmentalize each course as a discrete set of information that does not necessarily build on previous courses or they assume is not needed in future courses. When queried, students will deny having ever seen course information in the prerequisites they have completed. Faculty then often cover material again even though they suspect the students have seen it before. This does not effectively use the limited teaching contact time and means that less new material can be covered during the semester.

There are several methods for effectively using prerequisites that tie course content together from one semester to the next. One strategy is to give a pre-test at the beginning of the semester that covers the major topics where the students need to demonstrate proficiency. This pre-test should only cover the major competencies and should not be a comprehensive review of only the toughest course content from the prerequisite courses. Evaluation should be quick and should direct students to review material on their own at the beginning of the semester before the first course exam.

Another tool for highlighting prerequisite materials is to include large pieces of previous course content as parts of current homework assignments. A concrete example is to require students in their equilibrium thermodynamics course to compute a McCabe-Thiele diagram for distillation if they have already had the mass transfer course. This content should not be reviewed, but students should be directed to their previous notes if they have questions. To be effective, the problem should naturally tie in with the current course content. Students comment after a few assignments that they see the benefit of reviewing information in context and enjoy the opportunities of tying material together. In this work, specific examples from an equilibrium thermodynamics chemical engineering course are used to demonstrate how to implement this strategy in a course along with demonstrating the concrete benefits. Specifically, the incorporation of energy balances, material balances, ternary phase diagrams, and the Clausius-Claperon equation highlight how to bring past material back into focus for students. The use of open-ended design problems and ASPEN software bridges forward into the future core design course, as does the use of much of the reaction terminology and equations for moving students into reactor design.