ENGINEERING CULTURES: ADDRESSING CHALLENGES OF GLOBALIZATION TO ENGINEERING EDUCATION THROUGH HUMAN- AND CULTURAL-CENTERED PROBLEM SOLVING

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Abstract- *Globalization challenges US engineering students to prepare for work in a culturally diverse environment where they will encounter non-US engineers defining and solving problems. The purpose of this course is to help students learn about engineering in different times and places so they can recognize, understand, respect, and possibly even value perspectives other than their own.*

By defining problems in mathematical terms and problem solving as the appropriate application of equations, do engineering curricula prepare students adequately to work with engineers trained in distinct national traditions? How might engineering students be trained better to work in environments where the need for negotiation and compromise in the definition of problems is more the rule than the exception?

We teach *Engineering Cultures* as a series of modules, each self-contained but fitting the overall mission of the course as steps toward a more developed understanding of the dominant American approach to engineering problem solving amidst other approaches. The course's modules are the following:

1) Engineers and politics. We begin by posing this question, knowing that students are not ready to answer and that will gain significance throughout the course.

2) The Western Emphasis on Individualism. The course turns to help students understand how the cultural image of economic competitiveness has shaped engineering practice and education since the early 1980s.

3) Japan. Students learn about Japan, a nation whose dominant images do not include the individual person but where group identity serves as the main means for defining persons and what counts as *engineer*.

4) Soviet Union. Through a biographical account of an engineer of the Stalin era, students learn how Soviet engineers' technical work always had political content. Students also learn how the cultural images of both the USSR and the US shaped each other's technological development and engineering problem solving practices.

5) Engineering education reform. Through the history of the engineering pipeline and the Engineering Education Coalitions, students learn how engineering education reform in the 1980s and 1990s was a response to an image of Japan and the globe as economic threats to the American nation.

6) 20th century U.S. Through case-studies in 20th century history of engineering, we show students the origin of a key divide in contemporary engineering, between design and manufacturing. Here students also learn that doing good engineering work involves more than purely technical problem solving.

7) 19th century. Through analysis of case studies in 19th century history of engineering, students historically locate U.S. engineering disciplines through descent lines from civil and mechanical engineering and connect the origins of U.S. engineering to British and French engineering traditions.

8) European perspectives. Through case studies in the history of engineering in Britain, France, and Germany, students learn that what counts as engineering knowledge in Britain is craftsmanship, in France is mathematical theory, and in Germany is emerging quality/reason.

9) Asian perspectives. Here students learn that engineering practice and knowledge in different Asian countries are shaped by "historical particularism," such as the constant threat of occupation in South Korea or the cultural revolution in China.

10) Latin American perspectives. Students learn that engineering practice and knowledge are shaped by cultural histories of antagonism and collaboration with the U.S. in Mexico, by regional disputes and surges of nationalism against imperial nations in Colombia, and by servitude to the military, the church, and the aristocracy in Brazil.

11) Can engineers deal with politics? We pose this question again to students to reassert that politics is inherent part of engineering experiences and with the hope that students have reached the following conclusions: first, engineering problems mean different things in different cultural and historical perspectives; second, drawing a boundary around a problem has non-technical or political dimensions; third, engineering-problem solving, based on mathematics and engineering sciences, becomes only one resource among many for engineers to use yet remains a distinctive, crucially important resource.

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