

The University Senate of Michigan Technological University

PROPOSAL 23-04

GRADUATE CERTIFICATE IN SUSTAINABILITY

Introduction

This proposal recommends establishing a formal "Graduate Certificate in Sustainability". Emphasis in issues related to sustainability is currently available to graduate students who are majoring in separate disciplines (e.g., environmental engineering, chemical engineering, mechanical engineering, environmental policy) and there is no unifying course work in these separate departments. The Certificate would only be made available to students enrolled in graduate programs at Michigan Technological University.

I. Title of Certificate

Graduate Certificate in Sustainability

II. Catalog Description

Graduate students completing the required course work (and receiving a grade of "B" or higher in all the courses) will be awarded a "Graduate Certificate in Sustainability". This Certificate formally recognizes curricular breadth in the following areas: i) policy, societal, and economic systems, ii) environmental systems, and iii) industrial systems. The student has the opportunity to achieve specialized education in engineering, social sciences, business, and economics.

III. Rationale

Society, the environment, and economic/industrial development - the "triple bottom line" - are inherently interconnected, both domestically and worldwide. Without fundamental changes, our future is in jeopardy. Healthy survival requires a sustainable future, one in which human and industrial systems support an enhanced quality of life by recognizing and seeking to understand this interconnectivity. Change must begin in the place where most change is born - within our nation's universities.

Despite growing recognition of the importance of achieving the triple bottom line, graduate education has historically not reflected this reality. Our colleges and universities continue to train students to be experts in narrow disciplines, with little or no emphasis on the broader potential impact of decisions outside that discipline. This outcome is reinforced by traditional funding sources that require supported graduate students to be committed to the dictates of the project sponsor. Graduates often retain their myopic view of the world as they pursue careers. Mechanical and chemical engineers design products and plan manufacturing processes based on performance and economics, seemingly without consideration for potential societal or environmental consequences. Business people are focused on quarterly profit statements and the bottom line, frequently with little regard to society or the world around them. Environmental engineers and scientists often fail to consider the economic and societal implications of their actions. Social scientists and policy makers regularly make decisions that are poorly grounded on a technical basis. The segregated thinking of these individual disciplines leads to confusion, conflict, and disagreement, ultimately resulting in poor decisions.

Several years ago, faculty members from a diverse set of disciplines at Michigan Tech recognized this gap in the traditional education paradigm and began collaborating on sustainability issues. Their collaborative activity became the Sustainable Futures Model that will serve as the thematic basis of this proposed Graduate Certificate. The Sustainable Futures Model focuses on research and education in four areas: (1) environmental systems, (2) industrial systems, (3) societal systems, and (4) integrative initiatives that bring together all three of these areas. The Sustainable Futures Model is a meta-disciplinary endeavor that integrates information/insights from multiple disciplines and perspectives.⁽¹⁾

Recognizing the importance of this effort, Michigan Tech recently formed the Sustainable Futures Institute (SFI) to realize its vision (see, www.sustainablefutures.mtu.edu).

IV. List of Courses

This Certificate requires a total of 15 credits. Students must take a minimum of one class from each category provided in Table 1 and obtain a grade of B or higher in each of the courses. At least one half of the total certificate credits must be at the 5000-level or higher. This Certificate is only open to students enrolled in a graduate program.

V. Estimated Costs

There is no additional cost in introducing a "Graduate Certificate in Sustainability." All courses identified above are either required or elective courses available to all students who satisfy course prerequisites. ENG5710 (3 credit courses) will be submitted as a formal course during fall semester, 2003. ENG5710 will be offered in the fall semester and will discuss the underlying issues of sustainability, introduce the tools/methods needed for sustainability assessment, describe applications, and focus on policies most widely used in industrial states of the North.

A 1-credit pilot course co taught by Drs. Kathy Halvorsen and James Mihelcic (Sustainability Graduate Seminar, CE5930/SS5010) was successfully delivered spring semester, 2003. All other courses are offered on a regular basis.

Table 1: Course work used to Obtain the Graduate Certificate in Sustainability

Category	Allowable Courses (credits) (prerequisites)
Policy and Societal Systems & Economics	BA 4790, Ecological Sustainability and Organizations (3) prerequisites: UN 2002 EC 4600/EC5600, Natural Resource and Environmental Economics SS 5100 - Global Environmental Systems (3) SS 5200, Environ. Decision-Making (3) SS 5300, Environ. Policy and Politics (3) SS 5350, Environ. Policy Analysis (3) prerequisites: SS 5200 SS 5400, Sociology of the Environment (3)
Environmental Systems	BL 3850 Environmental Toxicology and Society (3) prerequisites: UN 2002 BL 4860, Toxicology * (3) prerequisites: BL 1020 or BL 1040 CE 4504 Air Quality Engineering and Science (3) prerequisites: CE 3501 or CE 3503 CE 4505, Surface Water Quality Engineering (3) prerequisites: CE 3501 or CE 3503 CE 4506, Application of Environmental Regulations and Pollution Prevention to Engineering Practice (3) prerequisites: CE 3501 or CE 3503 CE 5501, Environmental Process Engineering (3) CE 5504, Surface Water Quality Modeling (3) prerequisites: CE 4505 or BL 4451 CE 5505, Atmospheric Chemistry CE 5506, Air Quality Modeling (3) prerequisites: CE 4504 FW 3540, Remote Sensing and GIS in Natural Resource Management (3) prerequisites: MA 2720(C) or MA 2710(C) or MA 3710(C) FW 5550, Geographical Information Systems (3) prerequisites: MA 2720 or MA 2710 or MA 3710
Industrial	ENG 4500, Engineering for the Environment* (3) BA 4630, Manufacturing Strategy* (3) MEEM 5653, Life-cycle Engineering (3) prerequisites: MEEM 4900 MEEM 5685, Env. Resp. Design and Manf. (3) CM 4720, Design for the Environment (3)

* Recommended for students without a degree in science or engineering

¹ Sutherland, J. W., V. Kumar, J. C. Crittenden, M. H. Durfee, J. K. Gershenson, H. Gorman, D. R. Hokanson, N. J. Hutzler, D. J. Michalek, J. R. Mihelcic, D. R. Shonnard, B. D. Solomon, S. A. Sorby, "An Education Program in Support of a Sustainable Future," *Proceedings of the American Society of Mechanical Engineers (ASME)*, 2003.

Mihelcic, J. R., J. C. Crittenden, M. J. Small, D. R. Shonnard, D. R. Hokanson, Q. Zhang, H. Chen, V. U. James, S. A. Sorby, J. W. Sutherland, J. L. Schnoor, "Sustainability Science and Engineering: The Emergence of a New Metadiscipline," in press, *Environmental Science & Technology*, November, 2003.

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