COURSE NUMBER: 5070	COURSE TITLE: **Energy – Resources, Technology and Society**
TERMS OFFERED: Periodically	**PREREQUISITES:** Mathematics through ordinary differential equations and linear algebra, college physics and chemistry, thermodynamics or equivalent, heat transfer and fluid mechanics. Senior standing in undergraduate studies is required and/or at least first year standing in the Graduate School.
TEXTBOOKS/REQUIRED MATERIAL: Energy Systems Engineering, 2 ed. F. M. Vanek, L.D. Albright, L.T. Angenent McGraw-Hill, 2012 Selected journal articles and course notes. See attached list for Spring 2012.	**PREPARED BY:** **DATE OF PREPARATION:** 09-06-2012 **DATE OF LATEST REVISION:** 09-06-2012
COURSE LEADER(S): F. A. Kulacki	**CLASS/LABORATORY SCHEDULE:** M – W, 10:00-12:00 or as determined by departmental scheduling **CONTRIBUTION OF COURSE TO MEETING PROFESSIONAL OBJECTIVES:** 100% engineering topics
CATALOG DESCRIPTION: An intermediate treatment of energy from the perspectives of resources, technology and the societal impact. Scientific and technological underpinnings are described and analyzed for energy choices for the 21st Century. Topics include: energy systems analysis, energy conversion technologies, availability analysis, renewable and non-renewable resources, environmental impacts, and societal impacts of energy use patterns and energy policies.	**COURSE TOPICS:** 1 Fossil Resources: Quantity, quality and production (Hubbert Curve) 2 Resource Utilization: logistic and bi-logistic models, economic substitution. 3Non-fossil Resources: nuclear energy, renewable energy (solar, wind, biomass, etc.) 4. Thermodynamic basis for energy systems analysis 5 Parametric analysis of power cycles: temperature and property limited cycles 6 Climate impacts of energy use – natural and anthropogenic impacts 7 Direct energy conversion – an introduction

COURSE OBJECTIVES	1 To develop an integrated, trans-disciplinary view of the interplay between energy technology, resources, and related societal issues, such as policy formation, economics, and environmental impact. 2 To become familiar with the basic categories of energy conversion technologies and their attributes and to analyze energy systems employing conventional, renewable, and advanced energy conversion technologies. 3 To understand the basic concepts underlying economic substitution theory, models of growth, energy return on investment (EROI), and limits on energy efficiency.
COURSE OUTCOMES*	**(Letters shown in brackets are linked to program outcomes a-k)** **At the conclusion of this course students will be able to** 1. Evaluate analytically energy production trends and substitution dynamics (a,e,k) 2. Analyze parametrically power production cycles to determine optimum and related operating points (a,e,k). 3. Evaluate energy resource quality (EROI) (a,k) 4. Evaluate the link between energy use and normative standards applied to quality of life (a,e,f,h,j) 5. Communicate in professional and quantitative terms issues surrounding energy resources, use, and societal impacts (a,e,f,g,h,j,k)
ASSESSMENT TOOLS:	1 In class discussion of assigned readings 2 Written homework, quizzes and tests (midterm and final) 3 Assessment of term papers (mid-term and final) 4 Presentation of major term paper at end of course.

*ABET Assessment Outcomes:
Outcome a: "an ability to apply knowledge of mathematics, science, and engineering"
Outcome b: "an ability to design and conduct experiments, as well as to analyze and interpret data"
Outcome c: "an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability"
Outcome d: "an ability to function on multi-disciplinary teams"
Outcome e: "an ability to identify, formulate, and solve engineering problems"
Outcome f: "an understanding of professional and ethical responsibility"
Outcome g: "an ability to communicate effectively"
Outcome h: "the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context"
Outcome i: "a recognition of the need for, and an ability to engage in life-long learning"
Outcome j: "a knowledge of contemporary issues"
Outcome k: "an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

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Supplemental Materials
Spring 2012

Texts and Books

Ausebel, JH, and Sladovich, HE (Eds.), Technology and Environment, National Academy Press, Washington, 1989.

Fay, JA, and Golomb, DS, Energy and the Environment, Oxford University press, New York (2002)

Helm, JL (Ed.),Energy – Production, Consumption and Consequences, National Academy Press, Washington, 1990.

MacKay, DJC, Sustainable Energy – Without the Hot Air, UIT Cambridge Ltd., Cambridge (2009)

Nye, DR, Consuming Power – A Social History of American Energy, MIT Press, Cambridge, 2001.

Wolfe HC (Ed.), Efficient Use of Energy, AIP Conference Proceedings, No. 25, American Institute of Physics, New York, 1975.

Yergin, D, The Prize – The Epic Quest for Oil, Money and Power, Free Press, New York (1990)

Yergin, D, The Quest – Energy, Security, and Remaking of the Modern World, Penguin (2011)

Articles and Reports

Masters, CD, Root, DH, Attanasi, ED, Resource Constraints in Petroleum Production Potential, Science, **253,** 146-152 (1991)

Gates, DM, The Flow of Energy in the Biosphere, Scientific American, pp. 89-100 (~1970-1971)

Cook, E. The Flow of Energy in an Industrial Society, Scientific American, pp. 135-144 (~1970-1971).

Hubbert, MK, The Energy Resources of the Earth, Scientific American, **225**(3): 61-73 (1971)

Singer, SF, Human Energy Production as a Process in the Biosphere, Scientific American, **223**(3): 175-188 (1970)

Meyer, PS, and Ausebel JH, Carrying Capacity: A Model with Logistically Varying Limits, Technological Forecasting and Social Change, **61**(3): 209-214 (1999).

Meyer, P, Bi-Logistic Growth, Technological Forecasting and Social Change, **47**:89-102 (1994)