AC 2008-1344: TECHNOLOGICAL LITERACY AS A SCIENCE GE COURSE IN CALIFORNIA'S UC, CSU AND CCC SYSTEMS

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Abstract

The need for increase technological literacy (TL) in the general population has been discussed and emphasized in many forums. These discussions frequently emphasized the opportunities and responsibilities engineering educators have to developing this area of the educational curriculum. Engr 12, How Stuff Works – The Science Behind Things, at Santa Rosa Junior College (SRJC) is a new proposed course offering to address this TL need. The course attempts to deliver an understanding of both science and engineering to a non-technical audience within the framework of a general education (GE) science course that articulates with the University of California (UC) and California State University (CSU) systems. Counting the course as a UC GE science course was deemed crucial to meeting minimum enrollment requirements. Approval of SRJC courses involves both a local SRJC process followed by submission to state review boards for the UC, CSU, and CCC (California Community College) systems. This review process presented challenges and dictated course coverage and outline verbiage. A future engineering based technological literacy offering might be a UC transferable GE course in the category of social and behavior sciences. The focus would be on the political and technical institutions that govern our technological infrastructure (water, electrical power, transportation, communication, etc.).

Curriculum Process Update

The proposal and review process required for a UC or CSU transferable course is a lengthy one. Proposals are only accepted by the UC in the early Fall for an effective date the following Fall semester. The local college's process necessitates further time. Our college curriculum committee established a deadline for new courses in mid May. Initial drafts of the course outline for Engr 12, How Stuff Works, The Science Behind Things, were reviewed by another member of the Engineering & Physics Department at Santa Rosa Junior College in early April of 2007. With the retirement of the department's shared support staff person, it was initially unclear if the necessary data entry could be completed in time for the division level curriculum review meeting. At the first pass through the division level review, the scientists on the committee voiced enthusiastic support for the concept of an engineering focused GE science course. Suggestions were made to add more information about the structure and role of the lab material to the course, broader information within Topics and Scope, a wider spectrum of representative textbooks, and to add physics as an alternate discipline. This last suggestion was deemed inappropriate by the outline author because a physicist would lack the necessary exposure to the engineering design process that is an integral part of the course. An individual faculty member had expressed concern about the engineering discipline and proposed the course be cross-listed within physics. That opinion, though probably unworkable and inappropriate, was being championed by the corresponding dean. At the next run through with the division level committee, the listing for the discipline was further discussed with many other suggestions and alternatives discussed. There was no consensus and the course proceeded to the campus wide curriculum review meeting without physics or physical sciences as a listed discipline. No proposal for a related physics offering was developed. At the campus wide meeting in May, the same dean again championed the cross-listing and multiple disciplines approach. The issues were again unresolved and the proposal was tabled, but the dean in question subsequently retreated back to the faculty.

Towards the end of the summer, the author resurrected the proposal and resubmitted it to the process through the new dean. No further review at the division level was deemed necessary. The proposal went to the college's GE subcommittee where it won local approval as a science GE. There was some discussion at the full campus curriculum meeting requesting more detail on the lab portion of the course. The course received approval at the campus level without further significant changes and was on the UC and CSU systems.

Towards the end of the Fall semester '07, the author received news that the Engr 12 course had been approved for transferability to the UC and CSU systems. The next hurdle would be the UC General Education Review Committee whose official decisions would be sent in April of '08. The Engineering & Physics Department at SRJC would continue the planning for offering the Engr 12 class in the Fall of 2008.

In the middle of January '08, the author received unofficial feedback through the college's articulation officer that the UC GE committee had performed an initial screening of the Engr 12 submission. The feedback was not good. The committee will be rejecting Engr 12 for inclusion as a science GE for the UC and CSU system.

The SRJC Engr 12 course outline is included below and is also available at:

http://busapp02.santarosa.edu/SRCurric/SR_CourseOutlines.aspx?mode=1&CVID=7203&Semester=20087

Vince Bertsch
1/18/08

ENGR 12 Course Outline as of Fall 2008

ENGR 12 HOW STUFF WORKS

Full Title: How Stuff Works - The Science Behind Things

Units		Course Hours per Week		Nbr of Weeks	Course Hours Total	
Maximum	4.00	Lecture Scheduled	3.00	17.5	Lecture Scheduled	52.50
Minimum	4.00	Lab Scheduled	3.00	17.5	Lab Scheduled	52.50

Title 5 Category: AA Degree Applicable
Grading: Credit Course for Grade or CR/NC
Repeatability: 00 - One Repeat if Grade was D, F, or NC

Catalog Description:
A descriptive and interdisciplinary introduction to science through hands-on explorations into the inner workings of today's technological objects and systems. Intended for non-engineering majors. Specific case studies will span many categories including: energy and power, medicine, transportation, agriculture, manufacturing, construction, communications, entertainment. Each study will delve into the underlying scientific principles, the historical development and societal implications.
Prerequisites:
Corequisites:
Recommended Preparation:
Eligibility for ENGL 100 or ESL 100
Limits on Enrollment:
Schedule of Classes Information
Description:A descriptive and interdisciplinary introduction to the sciences through hands-on explorations into the inner workings of everyday objects and systems. Intended for non-engineering majors.

Prerequisites:
Recommended:Eligibility for ENGL 100 or ESL 100
Limits on Enrollment:

ARTICULATION, MAJOR, and CERTIFICATION INFORMATION

Associate Degree:		Effective: Fall 2008	Inactive:
Area:	C	Natural Sciences	
CSU GE:		Effective:	Inactive:
Transfer Area:			
IGETC:		Effective:	Inactive:
Transfer Area:			
CSU Transfer:	Transferable	Effective: Fall 2008	Inactive:
UC Transfer:	Transferable	Effective: Fall 2008	Inactive:

CAN:

Certificate/Major Applicable: Not Certificate/Major Applicable

Version:	01	Course Created/Approved:	5/21/2007
Version Created:	4/4/2007	Course Last Modified:	11/9/2007
Submitter:	VINCE BERTSCH	Course Last Full Review:	5/21/2007
Version Status:	Approved (New Course)	Prereq Created/Approved:	5/21/2007
Version Status Date:	5/21/2007	Semester Last Taught:	
Version Term Effective:	Fall 2008	Term Inactive:	

<u>COURSE CONTENT</u>

Outcomes and Objectives:

Upon successful completion of the course, students will be able to:

1. Identify and explain the scientific principles behind specific technological products.
2. Dissect a technological product or system, identify major functional components and trace the flow and/or conservation of energy, material and information.
3. Employ systematic data collection methods to collect accurate measurements in a laboratory setting.
4. Apply the fundamental principles of the scientific method and the engineering design process to the development and implementation of lab experiments and small design projects.
5. Apply computer tools, standard report formats, and oral reporting methods to compile, graphically represent, and deliver experiment data and results as well as to document a design or construction process.
6. Construct small design projects by applying basic scientific principles and engineering design processes.
7. Compare and contrast the fundamental principles of the scientific method and the engineering design process.
8. List and define the types of risk and safety issues related to specific technological products and systems.
9. Identify examples of how scientific inquiry and technological development are imperfect and ongoing evolutionary processes responding to human needs and wants.
10. Debate and appraise the societal and environmental impacts of scientific and technological developments.
11. Debate and judge the tradeoffs made during the design and construction of technological products or systems.
12. Debate and evaluate the merits of allocating additional societal resources to the further development of specific technological products or systems.

Topics and Scope

Central topics and themes include but are not limited to:

I. The scientific method and the engineering design process
II. Ethical frameworks of science and engineering

III. Conservation of energy and materials
IV. Cost-benefit analysis and the risks and safety of technological products and systems
V. The history and evolution of science and technology
VI. Scientific versus technical writing

The central themes will be explored through a series of (7-30) case studies. The case studies will build in complexity over the course of the semester and will span the broad numbered categories listed below. Specific lettered examples listed are intended as illustrative suggestions only.

1. Energy and Power
   A. Refrigerators
   B. Thermostats
   C. Light bulbs
   D. Microwave ovens
   E. Solar cells
   F. Fuel cells
   G. Turbines
   H. Nuclear power plants
   I. Electrical power grid
   J. Petroleum processing infrastructure
2. Medicine
   A. Prosthetics
   B. Insulin pumps
   C. Heart pumps
   D. X-ray machines
   E. CT and MRI imagers
   F. Medical diagnosis systems
   G. Medical information systems
3. Transportation
   A. Bicycles
   B. Segways
   C. Automobiles
   D. Mag-Lev trains
   E. Space shuttle
   F. Highway systems
   G. Ocean shipping system
4. Agriculture
   A. Grapevine trellis
   B. Archimedes screws
   C. Irrigation sprinklers
   D. Well pumps
   E. Fertilizer
   F. Waste water treatment systems
   G. Food processing facilities
   H. Agri-businesses

I. Genetic engineering
5. Manufacturing
   A. Wrenches
   B. Drills
   C. Computer chips
   D. Plastics
   E. Packaging
   F. Assembly lines
   G. Mines
   H. Chemical plants
   I. De-manufacturing and recycling systems
6. Construction
   A. Beams
   B. Dams and weirs
   C. Houses
   D. Skyscrapers
   E. Landfills
   F. Egyptian and Meso-American pyramids
   G. Oil drilling platforms
   H. Canal and water delivery systems
7. Communications and Entertainment
   A. Cell phones
   B. Ipods
   C. Violins
   D. CD & DVDs
   E. Televisions
   F. Computers
   G. Microwave transmission towers
   H. The internet
   I. Global positioning systems
   J. Mass media
8. Other
   A. Hair dryers or curling irons
   B. Land mines or improvised explosive devices

Laboratory work:

At least three lab periods will be allocated to each of the following emphases:

1. Mechanical Dissection
2. Scientific Investigation
3. Engineering Design
4. Oral, Graphical, and Written Presentation

The mechanical dissection labs will lay a foundation for the scientific investigation. The engineering design labs will then apply this technological and scientific understanding. Lab reports will incorporate both scientific journal formats and technical memo formats.

Assignments:
1. Reading from the textbook or instructor prepared materials
2. Weekly homework questions
3. Internet research
4. Research reports
5. Exams

Lab Work will include:

6. Dissection reports
7. Scientific investigation reports
8. Design challenges and associated technical memos
9. Oral presentation

Methods of Evaluation/Basis of Grade.

Writing: Assessment tools that demonstrate writing skill and/or require students to select, organize and explain ideas in writing.

Written homework, Lab reports, Term papers

Writing
15 - 35%

Problem solving: Assessment tools, *other than exams*, that demonstrate competence in computational or non-computational problem solving skills.

Lab Design Challenges

Problem Solving
5 - 15%

Skill Demonstrations: All skill-based and physical demonstrations used for assessment purposes including skill performance exams.

Dissection and Oral Presentation

Skill Demonstrations
10 - 20%

Exams: All forms of formal testing, *other than skill performance exams*.

Multiple choice, True/false, Matching items, Completion, Problem solving and Short Essay

Exams
30 - 50%

Other: Includes any assessment tools that do not logically fit into the above categories.

Participation

Other Category
0 - 10%

Representative Textbooks:

Bloomfield, "How Things Work, The Physics of Everyday Life", Wiley, 2006
Macaulay, "The New Way Things Work", Houghton Mifflin, 2007
Langone, "The New How Things Work: Everyday Technology Explained", National Geographic, 2004
Nat. Acad. of Engr., "Engineering and the Advancement of Human Welfare", Nat. Acad. Press 1989

Student Preparation

Matric Assessment Required:	Y	Requires English Assessment
Prerequisites-generate description:	NP	User Generated Text
Advisories-generate description:	A	Auto-Generated Text
Prereq-provisional:	N	NO
Prereq/coreq-registration check:	N	No Prerequisite Rules Exist
Requires instructor signature:	N	Instructor's Signature Not Required

BASIC INFORMATION, HOURS/UNITS & REPEATABILITY

Method of instruction:	02	Lecture
	04	Laboratory
Area department:	ENGR	Engineering/Physics
Division:	73	Science, Technology, Engineering & Mathematics
Special topic course:	N	Not a Special Topic Course
Repeatability:	00	One Repeat if Grade was D, F, or NC

SCHEDULING

Audit allowed:	N	Not Auditable
Open entry/exit:	N	Not Open Entry/Open Exit
Credit by Exam:	N	Credit by examination not allowed
Budget code: Program:	0000	Unrestricted
Budget code: Activity:	0901	Engineering

OTHER CODES

Disciplines:	ENGR	Engineering (requires master's)
	ENGRSP	Engineering Support
Basic Skills:	N	Not a Basic Skills Course
Level below transfer:	N	Not Applicable
CVU/CVC status:	N	Not Distance Ed
Non-credit category:	N	Not Applicable, Credit Course
Classification:	A	Liberal Arts and Sciences Courses
SAM classification:	E	Non-Occupational
TOP code:	0901.00	Engineering, General
Work-based learning:	N	Does Not Include Work-Based Learning
DSPS course:	N	NO
In-service:	N	Not an in-Service Course