Sustainable Products and Services
College of Business
Alliant International University

Instructor: David A. Bainbridge, Associate Professor

The course
Yet at its heart, eco-industrialization is about the recreation of community… Ed Cohen-Rosenthal

This course will change how you look at the world, how you design and shape the spaces around you, and how you select and use time, tools, materials, and space. It provides a broad introduction to design and meeting human needs, covering how we interact with the environment around us, how to make things fit and feel better (ergonomics), improve productivity and health, substitute services for ownership, and use materials and manufacturing methods that are earth and people friendly. Methodologies for accounting for and the ecological costs of products and services will be included.

This course includes case studies, design projects, labs, and experiments. It provides methods for determining needs, developing research teams, and finding solutions to difficult design problems. It also looks closely at the systems implications of design.

This is specifically developed as an introductory course about the design of eco-effective goods and services. It is also designed to help students rediscover their creativity and ability to find new solutions to complex problems.

Required Texts:
Victor Papanek. 1999 [1972]. **Design for the Real World**.
Bill McDonough and Michael Braungart. 2002. **Cradle to Cradle**.
Highly recommended: Don Norman 1988. **The Design of Everyday Things**.
Ed Cohen-Rosenthal. 2003. **Eco-Industrial Strategies**.

Supplementary notes and assignments will be available on the Alliant Blackboard site, stay connected and look for weekly updates

Additional materials for class
You will need: 1) cloth measuring tape 2) a small ruler (about 6 inches) 3) a blank (no-lines) notebook for sketches (preferably 8 x11" or larger), 4) pencil with eraser and felt pen (fine tip), and 5) folder or portfolio pouch to keep class materials in for assembling your portfolio at the end of class.

Schedule
1. Sustainability and design
 You can't eat GNP. The triple bottom line. True cost, life cycle cost, MIPS, MFA, and ecological footprints. GNP vs ISEW. Why progress bites back. Global change and investing for the future. Design, defining the problem, a tragic history. How things don't work, intro to materials and tools, manufacturing and waste. Design discipline. Perfectly perverse incentives for disaster by design. Systems failures and opportunities. The green imperative. Stimulating your curiosity and creativity.   Papanek Ch. 1,2, McDonough intro.
DRAWING EXERCISES-BRAINSTORMING-CREATIVITY

2. Design responsibility and design intent, opportunity, and joy. Papanek Ch. 4,5,6, McDonough Ch 1
Life cycle costs, biometrics, systems effects, integration and interaction. LCCA, audits and analyses. Industrial ecology. Communicating clearly. Design intent, problem definition and teamwork, ethics Papanek Ch. 7,8,

selections from Norman. Durability, useful life, quality and reparability. Design for disassembly, reuse or recycling. Green materials. Facilitating participation, working with clients. Steps in building, finding resources in the library, the hardware store, and other guides. DESIGN FOR DISASSEMBLY LAB.

3. Learning from others.   Papanek Ch. 9,11
The genius of the Inuit, lessons from history. Nomadic furniture and housing, . Discipline in design. Organic architecture. Natural materials, ecocomposites, light straw clay, cashew nut shell resin and chicken feather plastic. DESIGN PROJECT IN CLASS - BUILDING BRIDGES.

4. Ergonomics, comfort, and productivity.
    It's really all about people. Making things fit. Ergonomics handout, daylighting handout. Measuring people at work, rest and play. Assessing designs and helping people make their environments fit them better. Shoes, chairs, benches, airplanes and other instruments of torture. Statistics matter, means and outliers. Why design failures lead to mistakes and accidents. Lighting for safety, productivity and health. Daylighting and student performance. Productivity outweighs all other benefits of good design.

5. Universal design
Universal design, disabilities and disadvantaged. ADA, suppl. readings. The senses. Physical, visual, aural, and other limitations. How we hurt ourselves at home. Making products explain themselves. Helping making life less dangerous and more pleasant. We will all be disadvantaged at times, design can make life better.
IN CLASS DESIGN PROJECT: COMPUTER STATION OVERHAUL AT LOW COST.

6. Meeting human needs. The basis of eco-effective design.   Papanek Ch 12, McDonough Ch 2
ecological living, sustainability and economics. The psychology of consumption, wanting and needing. Status and excess. Why subsidies are killing us. Industrial ecology and global change. Eco-efficient and Eco-effective design across society. Consumer goods, durables, clothes, shoes, etc. HOME DESIGN PROJECT: BRING YOUR DELIVERY DEVICE FOR EGG DROP TEST IN CLASS. POST TEST ANALYSIS AND BRAINSTORMING.

7. Eco-effective services – substituting services for product ownership.   McDonough Ch 3
Sharing v/s buying, leasing v/s owning. Overview of service in America. Making more with less. Water, energy and resource conservation in housing. The health benefits of good design. Alternative building materials. Climatically adapted, green buildings. Homeowners manuals. Green hotels. Green hospitals.
BRAINSTORMING LAB: SERVICE OPPORTUNITIES.

8. Waste equals opportunity – rethinking society.   McDonough Ch 4
Restructuring the world in Nature's image. Industrial ecology, biomimicry, recycling, mining waste streams, recovering lost materials, harvesting the sun, working with ecocomposites. Integrating farms, gardens, and industry. Protecting and enhancing Nature's services and Natural capital. Clean and green, "Would you want your children to play here?"
DESIGN WORKSHOP: ECOCOMPOSITE LAB.

9. Community design   McDonough Ch 5, 6, Village Homes and Curitiba reading
The self-reliant, sustainable community. Lessons from the past, Village Homes, Soldiers Grove, and other successes.
Making cities work. Ecocity projects and Curitiba, Brazil. Water, energy, transit, flood control, parks. Bicycles, light rail, jitneys and buses. Earthquake responsive design.
A landscape for humans. Wrap-up - sharing solutions and challenges.

Course requirements and grading.   **PTS**

1. RESEARCH PROFILE (WORD SEARCH AND HITS)   10

2. COMPUTER STATION EVALUATION (ERGONOMICS)   10

3. PRODUCT OR SERVICE PROPOSAL   10

4. 2000 WORD RESEARCH PAPER – FULLY REFERENCED, CITATIONS   10

4A. FOR GRAD STUDENTS ONLY: AN ENVIRONMENTAL AND HEALTH PROFILE COMPARING PAST WITH PRESENT PRODUCT VERSIONS: I.E. WOOD SURFBOARD, HOLLOW, BALSA, FOAM AND GLASS or TEFLON COATED FRYING PAN VERSUS CAST IRON). DESCRIBE HISTORY, INVENTORS, KEY PEOPLE, LCCA, KEY ISSUES.   *10*

MIDTERM – MULTIPLE CHOICE AND ESSAY

(FROM LECTURES, DISCUSSIONS AND READINGS)   **10**

5. PRESENTATION OF A SHORT TALK ON PAPER OR CRITICAL TOPIC   10

6. IN CLASS ASSIGNMENTS   10

CLASS PARTICIPATION (BE ON TIME!)   10

7. PORTFOLIO (lab exercises, sketches, design ideas, labs, notes)   10

FINAL EXAM -- MULTIPLE CHOICE, FILL IN THE BLANK,

ESSAY AND PROBLEMS   **10**

Additional reading:
The First Five Pages by N. Lukeman, excellent review of writing well.
For your business bookshelf
Allenby, B.R. and D.J. Richards. 1994. The Greening of Industrial Ecosystems.
Benyus JM. 2000. **Biomimicry.**
Brown, L.R. 2001. Eco-Economy.
Cohen-Rosenthal, E. and J. Musnikow. 2003. Eco-industrial Strategies.
Corbett, J and M. 2000. Designing Sustainable Communities.
Curran, M.A. 1993. Broad-Based Environmental Life Cycle Assessment. Environmental Science and Technology. 27(3):430-436.
Dresner, S. 2002. The Principles of Sustainability.
Daily, G.C. ed. 1997. Nature's Services.
Daily, G.C. and K. Ellison. 2002. The New Economy of Nature.
Graedel, T.E. and B.R. Allenby. 1995. Industrial Ecology.
Hanley, N., J.F. Shogren, and B. White. 2001. Introduction to Environmental Economics.
Hawken, P. 1987. Growing a Business.
Hawken, P. 1993. The Ecology of Commerce.
Hawken, P., A. and L.H. Lovins. 1999. Natural Capitalism.
Kira. 1976. **The Bathroom.**
Levinson, J. Guerrilla Marketing.
Levinson, J. et al. Guerilla Publicity.
Norman, D. 1992. Turn Signals are the Facial Expressions of Automobiles.
Margoluis, R. and N. Salafsky. 1998. Measures of Success: Designing, Managing and Monitoring Conservation and Development Projects.
Papenek, V. 1995. **The Green Imperative**.
Petroski, H. 2003. **Small Things Considered: Why There is No Perfect Design.**
Petroski, H. 1994. Design Paradigms: Case Histories in Error and Judgement in Engineering.
Perkowitz S. 2000. Universal Foam: From Cappuccino to the Cosmos.
Porter, M.E. and C. van der Linde. 1995. Green and competitive. Harvard Business Review, Sept. Oct.: 120-134.

Roebuck et al. 1975. Engineering Anthropometry Methods.

Roodman, D.M. 1998. The Natural Wealth of Nations.

Salvadori. 1980. Why Buildings Stand Up.

Socolow, R., C. Andrews, F. Berkhout and V. Thomas. 1997. Industrial Ecology and Global Change.

Stewart, B. 1987. Improved Wood, Waste and Charcoal Burning Stoves.

Stiglitz, J.E. 2002. Globalization and its Discontents.

Tenner. 1997. **Why Things Bite Back: Technology and the Revenge of Unintended Consequences.**

Weisbord, M. 1987. Productive Workplaces.

Instructors favorites in bold.

WEB

International Society for Industrial Ecology

United States Society for Ecological Economics – membership free for students

U.S. Dept of Commerce   http://www.osec.doc.gov/eda/html/2b2_5_eco-industdev.htm

ICC Business Charter for Sustainable Development http://www.iccwbo.org/sdcharter/charter/about_charter/about_charter.asp

Global Reporting Initiative www.globalreporting.org

The Step-by-step Sustainability Scheme. International Network for Environmental Management (INEM) and German Environmental Management Association (B.A.U.M.) http://www.inem.org/htdocs/articles/sustainability_scheme.html

Business and sustainable development   http://iisd.ca/business/

Eco-efficiency - creating more value with less impacts, WBCSD, 2000 http://www.wbcsd.ch/newscenter/reports/2000/EEcreating.pdf

Eco-efficient service http://www.wupperinst.org/Projekte/SuE/HTMLtexts/Pages/t_2_5.html

Lifecycle and EcoIT   http://www.pre.nl/

The National Center for Eco-Industrial Development http://www.cornelldailysun.com/articles/1202/

Solar design http://www.sustainableenergy.org/resources/technologies/solar_passive.htm

The course

Course goals for understanding
1. Demonstrate a global outlook and understanding of the meaning of sustainability
2. Demonstrate competence in ecological accounting (MIPS, MFA, LCCA).
3. Develop critical thinking skills and ability to assess the quality of information and its importance.
4. Understand the interconnectedness and interdependence of individuals and cultures.
5. Understand the interdisciplinary nature of knowledge and problem solving
6. Appreciate the essence of compromise in all design solutions

Course objectives
1. Integrate each student's unique experiences and background into class.
2. Improve competency in interpersonal communication with oral, written, quantitative and computer skills
3. Develop increased respect and understanding of "others", especially the skill and intelligence needed for subsistence and survival in difficult and changing environments.
4. Apply critical analysis to interpreting and addressing current world challenges.
5. Interpret and present important information for classmates.
6. Develop systems thinking to solve complex problems and develop sustainable solutions.
7. Learn to work well with teams in analyzing and presenting discussions and displays of important concepts and papers.

Course assessment, grading A-F
1. Class understanding, writing, presentation, exams, portfolio.
2. Class participation (attendance and engagement)
3. Communication - presenting information to class.
4. Points and expectations for each assignment will be further described in class. If unclear-ask!

Assignments
#1: Research and Notes

This is training for effective library and internet research. Conducting research effectively and managing information well is essential to succeed in most careers. Research helps you find out how, why, what, where, and when. Improved research skills help you spend your time thinking and making connections.

Step 1: Choose a research topic. This might be any one of our key topics in class for a specific country, such as packaging take-back requirements in Germany; eco-effective design in Sweden; ergonomics rules and regulations--a country comparison; avian toxicity from overheated Teflon™ pans; an ecological cost comparison of wood, vinyl and aluminum siding; the effect of the Hubbert's peak on business planning 2020 and beyond; mining solid waste dumps in 2050; substituting service for sales (carpets, lighting, and ??); or the policy implications of adopting MIPS analysis and labeling for all new products.

Step 2: Develop a short list of key words for the search - include as first section. Choosing search terms and using Boolean logic (and/or/order) to limit results is essential. Different browsers and data bases use different markers to set word order, adjacent words, etc. Always look up and use advanced or expert searching "help". Quotation marks can be used "to include phrases" in most browsers. Using additional key words can limit search results to only the best resources. Sustainability is a good filter word for this class.

Step 3: Start with the excellent resources of the AIU library (or use resources at UCSD). **http://www.library.alliant.edu** (you will need to set up password for off campus use). Begin with OCLC First Search which connects you to 37 databases! Look at the list, become familiar with the major data bases. Some of these allow access to other data bases.

Start here with your search term(s) and try a few data bases: ArticleFirst, Eco, and WorldCat, perhaps Business Management and Alternative Press. Your search term will be saved as you jump data bases, but remember to push the search button. If you get too many hits add more terms, to few take away quotation marks. Keep track of your results as hits or printed pages of hits! If you search in a university library you can get help from the reference librarians.

Then from the First Search home page jump to advanced searches and try Agricola (the National Agricultural Library); **Business premier** is outstanding with many full text articles and a feature that lets you choose journal articles or magazines; Newspaper source; **PapersFirst** (recent talks-very good for current affairs or developments in business); WilsonSelectplus; etc.

You should master **Lexis-Nexis** to get current information from newspapers and legal databases. On your research history describe where you went and how many "hits" you found. List your search strategy and results. You must report results for at least five data bases. In other places you can find the San Diego Union Tribune Newspaper Index (since 1991) and Medline at the National Medical Library is also a very useful tool.

List results of your search for your key words with hits per database for 10 databases, try to find full text on line. For example I did a quick search on biodiesel. OCLC WorldCat 150, Wilson select 60, Eco 20, Econlit 4. AGRICOLA 124, PapersFirst 263 (a hot topic), LexisNexis 125,

Newspaper source 144, Business Source premier 31 scholarly and 179 magazines, BusinessIndustry 67.

On your research history describe where you went and how many "hits" you found. List your search strategy and results. You must report results for at least ten data bases. In other places you can find the San Diego Union Tribune Newspaper Index (since 1991. Medline at the National Medical Library is also a very useful tool.

Step 4. The California Digital Library - Searchlight

The University of California and cooperating libraries are moving more material to the web every day. Their cross data base and library search is called Searchlight. Try it. http://www.cdlib.org/ This offers two broad search areas: <u>Science and Engineering</u> & <u>Social Sciences and Humanities</u>. Try a search with your key words.

List results of your key word search in Searchlight.

Step 5. Melvyl
The University of California libraries' data base of their books and periodicals can be very helpful (more than 7 million entries). There are many specialized databases at UCSD's libraries including many CD based data bases. Free weekend parking makes it well worth visiting - you can identify location of journals and magazines and books before you go. You must include the results for a search for books with your research title words in Melvyl: http://www.melvyl.cdlib.org/
(The UCSD only directory is ROGER).

Provide a list of books on your topic you find in Melvyl with shelf numbers and full citation detail.

Step 6. Web Crawl. Use at least 2 search engines.

The worldwide web is a powerful research tool. Search engines or browsers such as: http://www.google.com, or …Yahoo, or …They are indexed and assembled using different strategies and often provide very different results. Use additional terms to limit results to just what you need. Always use advanced searching. In many databases words can be combined using quotation marks. Work on your key word list to narrow down hits to 20 or so that are all likely to be of use. Don't use the words <u>corn plastic</u> to look up natural plastics (450,000 hits) but try <u>"corn plastic" sustainable</u> (15 hits).

Manufacturers or advocacy groups often support Internet sources and information is not always complete or truthful so review them carefully. Give greater weight to neutral and peer reviewed academic journals, books, and important newspapers (NY Times, LA Times). Many are now available on-line.

List your search results. You must have at least two different search engines in your search profile. You must identify the search engine, provide the URL for the search engine home page, the search terms you use and the number of hits. Chronicle the terms you added to reduce the number to a manageable number of sites to review.

Step 7. Sample Notes
These library and web resources will help you improve your understanding of your topic. Don't plagiarize them. Many students are not familiar with good note taking. This requires practice and I will give you feedback on your note taking. Transcribe the information and make notes in your own words.

You must turn in a sample from your research notes--which should be computer printed, providing full reference data and shelf numbers or URLs as well as your notes.

> **You must turn in your notes from at least two of your key sources: one from the library or a scientific journal and one from the web. Include all relevant citation information. Notes should be in your words not copied from text or book directly.**

Step 8. Two internet site reviews on sustainable production and operation.

For this assignment review a number of sites that address questions covered in this class and find a good one and an awful one - then write a short review for each (1/2 to 1 page). These will be shared with the class so be accurate in listing the full URL. These are to be short – preferably 1/2-1 page each. Use the internet review suggestions below. List the full site address, how you found it (which browser), what you like or dislike about it.

Web pages and the internet/worldwide web have become an important source of information presentation and research and critical for most business yet many are awful. Much of the information is poorly presented, organized little, and often of questionable validity. Consider such things as:

1. Screen Design and Layout
How does each page utilize the screen? Does the layout draw you in or does it look like it was just sort of dropped there? Are page/screen sizes consistent or do you have to keep resizing the window as you move through the site? Does your eye feel invited to "go with the flow" or is it assaulted? Can you print the screen? Does it fit on one page or is it so wide it drifts onto a second?

2. Information Design
Is the information broken up into digestible chunks? Is it broken up into segments that make sense logically? Is it "nested" logically? If there are long blocks of copy, are descriptive subheads used to help organize the info and give the reader a preview/overview? Can you jump text with buttons or links?

3. Text as a Graphic Element
Is it readable? Too small/too big/just right? Does the typography (font) - especially that used for titles and headlines -- fit the subject matter and audience? Is its use consistent?

4. Copy
Does the information make sense? Is there jargon? Are there misspelled words or other typos? Does it provide the information you were expecting? Does it actively engage you? Are you bored reading it?

5. Navigation Scheme
Is it easy to move throughout the site? Does the navigation make sense? Do you feel like you are lost or did you actually get lost? Are the links consistent? Do you have a sense of what the icons mean before clicking? Do you get booted out? Or worse yet, locked in so you can't go back?

6. Stylistic Unity
Does the site maintain a consistent style? Or appropriate changes in different sectors?

7. Graphics and music
Are graphics optimized or compressed properly? Do they look jaggy, shimmery, squished, have weird halos, edges that look odd, or anything else that makes them look unprofessional? Are the photos clear and crisp or out of focus with pixels showing. Is there music or video?

8. Colors
Do the color choices make the information easy to read? Do they create an atmosphere suitable to the subject? do they work well together?

9. Usability
Does it load quickly? Does everything work? Can you tell that something is not appearing or not performing as it is supposed to? Do you get error messages?

10. Links

Are there links to other related sites? Do they work? How is the quality of the links?

Overall: Information quality and authority

Does this site have credible, reliable and understandable information? Is it referenced? Is the author identified? Is the research plausible and are sources of information identified? What possible bias might it have? Does it draw you in, keep you interested, and prevent you from getting lost and confused? Does it tell a story? Would you recommend it? How could it be improved?

Thanks to Sally Gill for suggested internet review guidelines
Further reading: Alexander, J.E. and M.A. Tate. 1999. Web Wisdom. Lawrence Erlbaum Associates, New Jersey 156 p.

#2. Computer station evaluation

Evaluate your home or work computer station using the form given in class. Measure angles, cm and be complete in describing problems or aches and pains. If you have two computers evaluate the worst setup.

#3. Replacing a product with a service (one page)

Looking at the world around you, find a common product that could be replaced by a service to reduce environment costs. For example: it is now possible in some cases to rent the carpet in an office building. The manufacturer benefits by making the carpet as durable as possible, fully recyclable, and low maintenance. The building owner benefits because she no longer has to worry about buying, cleaning, or replacing the carpet. She just pays a predictable monthly fee.

#4. Research paper or business plan, 2000 words (+ or - 50 words)

MUST be typed, 1.5 or double spaced in 12 point Times or similar font, 1.25 inch margin on the left and 1 inch margins on all other sides. Except in cases where original investigations are done, your paper will be a report on investigations by others so you must <u>be sure to give credit where it is due with proper citations and references.</u> The penalties for plagiarism are spelled out in the student handbook--zero for the assignment plus other penalties if serious.

4A. FOR GRAD STUDENTS ONLY: YOUR TOPIC MUST EXPLORE THE ENVIRONMENTAL AND HEALTH PROFILES OF A PRODUCT OR MATERIAL COMPARING PAST WITH PRESENT VERSIONS: I.E. WOOD SURFBOARD, HOLLOW BOARD, BALSA AND GLASS, FOAM AND GLASS or TEFLON COATED FRYING PAN VERSUS CAST IRON). DESCRIBE HISTORY, INVENTORS, KEY PEOPLE, LCCA, KEY ISSUES.

You must use at least **five reputable business magazines or papers or five scholarly papers or books** for your paper (preferably 10). You may also add up to five internet sources in addition to the "permanent" references. For cutting edge topics interviews may be substituted for 3 of the references. There are books on reserve to help you get started. Use professional journals (Journal of Industrial Ecology, Journal of Cleaner Production), magazines and newspapers (the Economist, Wall Street Journal, New York Times), government documents, and scholarly books as primary source materials (UCSD library is a good resource). When you use an investigator's data, state his/her ideas, paraphrase his/her conclusions, or quote him/her directly, cite the reference as follows at the end of the sentence the first time their work is used in a paragraph (Altieri, 1995). Follow the reference format information for the Journal of Ecological Economics (find it on-line Instructions to Authors)).

No footnotes, use direct quotations rarely, and only when they are essential to your argument. In most instances you should paraphrase the information from your sources, giving credit to authors by citing their paper or book. Contact the Academic Success Center in building M7 for help. The individual paper topic must be about sustainable product issues, i.e. the sustainable shoe, the sustainable book, the sustainable house. If you can't

think of a topic I will help you. Possible topics: sustainable design to meet a critical resource need in your country or globally, i.e. "Water harvesting Amman" What economic factors have led to problems? What environmental and social costs are involved? What has been suggested as a solution?

If you choose to do a business plan you might follow this outline. Be realistic, document claims, reference articles and reviews, be flexible, optimistic, highlight your unique characteristics. A short version might only include: 1,4,5,7,8,9

A typical business plan
1. Introduction – cover letter, cover sheet, table of contents
2. Executive summary – two to four pages to convince someone to read the whole thing
3. The business environment – where your company/product/service fits, trends for sector, opportunities, future
4. The business profile – what you will do, who you are and why it makes sense, organization, operation, legal base (patents, copyrights, etc.)
5. The market -- consumers/clients (who, how many), competitiveness with competing products or services, geographic area, ability to meet needs, retention and recruitment of more consumers/clients
6. Anticipated challenges and resource requirements – competitors, your edge, weakness to overcome, protection of ideas or design, staffing, training, depth of management
7. Marketing – selling the product or service, publicity, promotion, merchandizing, market research
8. Financial projections – past, profit and loss, balance sheet, cash flow
9. Implementation
10. Resource needs (if seeking funding or cooperation)
Appendices

GRADING for PAPERS (I allow papers to be corrected, resubmitted and regraded)

1) Innovation and thoughtfulness	20
2) Analysis/understanding	**20**
3) Structure and order, focus	10
4) Grammar	10
5) Style-is it engaging, readable	**20**
6) Citations correctly used	10
7) Quality of citations and searches	**10**
Total score possible	**100 points**
Deductions for spelling errors or wrong words	-5 points for each word
Deductions for incorrect margins	-5 points for each
No page numbers (handwritten doesn't count)	-20
Inappropriate topic (doesn't answer question asked)	up to -30
Plagiarism (inappropriate copying of web page or other paper	**- no points for paper, no rewrite)**

#5. Presentation

Presenting ideas is critical in business and community life. Your short talk can cover your research paper or an aspect of course role playing/simulations. Choose something of interest for your classmates. Expect to talk for about 10 minutes. Turn in your PowerPoint, OH transparencies, or display. Start using PowerPoint if you have not used it before. Your time as presenter is valuable - make sure it counts. More details will be provided in class. We will try to post the best papers and presentations on the AIU web.

#6. In class assignments
Thinking fast and writing and communicating clearly are required in business and essential for selling ideas. In class assignments will include: design sketches, design projects, lab exercises, experiments, outlines, notes, e-mails and memos, business plan outlines, and marketing outlines. These will be turned in as the portfolio.

#7. Final assignment – assemble your portfolio. All in class notes, papers, sketches and design work will be turned in the final week. This is 10% of your grade – so don't put it off to the last moment. Think about how best to organize and display the materials and information. Don't forget the commentary sheet given to you in class. This will be returned to you after grading. It is a good idea to keep notes and assignments from classes in the field you hope to pursue as a career. They can be used to show the kind of work you can do for a potential employer.

Final exam
Multiple choice, fill in the blanks, essay and problems will cover the full content of the course. Read, take notes and practice with problem sets provided.