

## An Emerging Field - Ecological Engineering Education



A compilation of the available information on education programs in Ecological Engineering on the internet.

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*"I am interested in ecological engineering. I currently have a masters in environmental engineering and am looking for a school to get a Ph.D in a similar field. Do you know of any good schools in the U.S.A." (Email request from the USA)*

*"I have applied to various universities for doing M.S. program in Civil& Environmental Engineering starting FALL-2000 with Ecological Engineering as my Major. I am very enthusiastically looking forward to work in this field. In this regard, I require your valuable assistance to achieve my dream of contributing something substantial in the field of Environmental Engineering." (Email request from India)*

### Why this article?

Ecological Engineering is increasingly interesting for students, today. I keep getting requests from various parts of the world, asking for advice and for contacts in this field.

In the old days (which is 5-10 years ago...), the only way to get in touch with interesting programs or good teachers was by personal contacts, e.g. via a professor or teacher, or by long brainsplitting research sessions in the local university library. Provided it was good.

Today, the internet offers much better and easier opportunities for anyone. It is the easiest way to get in touch with schools all over the world. This is a great chance for a scattered community like ours.

I considered it worth while to make a survey of the institutions present in the internet and assess them according to their compliance with the definition of Ecological Engineering.

### For the benefit of whom? Or: What is Ecological Engineering?

No great wonder: There is no consensus among the institutions present in the internet, what Ecological Engineering actually is.

- Some define it as the "design of sustainable **eco-systems** that integrate human society with its natural environment, for the benefit of both" (e.g. Texas A&M University).
- At UC Berkeley the "essence of the subject is to provide the **quantitative information needed for engineered solutions to ecological problems**", and applied limnology and oceanography are regarded as the backbone of the field.
- The Graduate Ecological Engineering Society of the University of Maryland, sees it as goal, "to observe and **exploit** the evolutionary wisdom of biological systems".
- The probably most open-hearted definition comes from Japan's Toyohashi University: "To sustain the development of **human activities** and ensure the **future of mankind**, [Ecological Engineering] aims to provide technological support for **redressing, maintaining and improving** the ecological cycle on the earth".

The definition I consider the most comprehensive, yet ethically acceptable is by Bergen et al., 1997 (found on Texas A&M's website):

**"Ecological Engineering is the design of sustainable systems consistent with ecological principles that integrates human society with its natural environment for the benefit of both".**

Even this short choice of citations shows the great divide: "Exploitation" versus the "benefit of both" This is the old question: Are we allowed to do what we are able to do?

It is – like always – a matter of attitude.

## The assessment

In my eyes, a good Ecological Engineering program should fulfil the following criteria:

- **Engineering:** The future professionals will do practical work for clients with a problem they want to have solved. Any program should therefore provide engineering skills, e.g. systems design, applied mathematics, risk assessment etc.
- **Ecology:** Ecological Engineers need a solid background in natural sciences, especially in ecology, systems theory and modelling.
- **Skills in social sciences:** To be able to integrate the designed systems with nature and society, Ecological Engineers need to know a lot about society, people and the way they interact.
- **Practical training:** Is absolutely essential to learn how to deal with the complex and tightly interconnected phenomena in nature. Ideally, students should learn to work in a project oriented setting.
- **Ethical questions and value issues:** If the designed systems are to be measured at the definition "for the benefit of both humans and nature", ethical questions must be addressed.

Based on these five elements I performed a basic assessment on the presence or absence of these elements in the information available on the internet (see Fig. 1). The vision was, to proceed like a student might do it who wants to sort out the school that suits him or her best.

I assessed 4 institutions that offer Ecological Engineering programs. I also included 1 institutions which offers "Bio-Resource Engineering" to broaden the view and help clarify the differences between the two related fields.

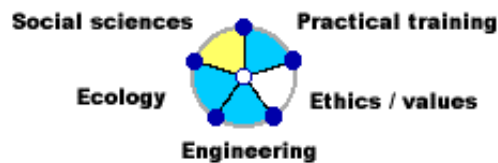


Fig. 1: Elements of the assessment: Blue filling stands for that specific requirement being present. Yellow filling indicates some doubts that the respective element is taken seriously into account. Blank stands for the absence of any hint, that that element is part of the program offered.

## 1. Grand old lady Certificate in Ecological Engineering at the University of Florida, USA



The University of Florida, academical home of H.T.Odum, has been offering an area of specialization in EE since 1970. Today, it offers a certificate in Ecological Engineering as part of its Systems Ecology program. The certificate is open to graduate students and individuals. The program consists of 21 semester hours of course credit. Students must complete a research project.

Graduate coursework focuses heavily on **engineering skills** (in the areas of wastewater treatment, potable water systems, groundwater, solid waste containment, groundwater, air quality), and on aquatic and wetland **ecology**. Social sciences and ethical questions are not addressed on their website. UF's research projects have a **strong focus on practical problems**, e.g. the development of sewage treatment systems.

**URL** <http://www.enveng.ufl.edu/homepp/brown/syseco/default.htm>

**Last update of site** No information found

**Undergrad studies** No

**Graduate studies** Yes

**Ph.D.** Yes

**Financial support** No information found

## 2. Newcomer Masters in "Ingenieuroekologie" at the Fachhochschule Magdeburg, Germany



Fachhochschule Magdeburg in East Germany (a technical college or polytechnic) is the first institution in Germany that offers an Ecological Engineering Masters program. The first program has been started in spring 2000. The program is open to students with a Bachelor degree (or a German "Diplom") in engineering or science. It consists of 52 semester hours in 3 semesters. Students must complete a thesis. Approximately a third of the courses are held in English, the rest is in German language.

Coursework focuses on **engineering skills** (e.g. hydraulic engineering, water management, resource management, eco-balancing, eco-controlling, landscape planning etc.) and on **environmental science** (e.g. hydrology, environmental biotechnology). **Environmental politics and environmental law** are part of the schedule. German technical colleges traditionally have a strong focus on **practical issues**. Ethical questions are not part of the schedule – at least they are not visible on the website.

<b>URL</b>	<a href="http://www.fh-magdeburg.de/studium/moegl/stgioe.html">http://www.fh-magdeburg.de/studium/moegl/stgioe.html</a> [in German]
<b>Last update of site</b>	Beginning of 2000
<b>Undergrad studies</b>	No
<b>Graduate studies</b>	Yes
<b>Ph.D.</b>	No
<b>Financial support</b>	No information found

## 3. All kinds of Masters in Ecological Engineering at the University of California, Berkeley, USA



The Civil and Environmental Department at the University of California Berkeley (UCB) offers a Master and a PhD program in EE "providing opportunities to students with engineering or other backgrounds to focus on the interface between natural sciences and engineering". The Masters program is open to students with a major in applied ecology (or an equivalent). The Doctoral program allows a wider range of backgrounds. Students must take a minimum of "20 units course work" for a Masters and complete a thesis.

The little information published on the website suggests, that the main focus is put on "all kinds of wet habitats" and – more than in the other institutions described so far – on **aquatic science and ecology**. Social sciences and ethical questions are not being addressed on the website. I assume that the **practical training** at UCB will focus on good science as well.

A whole range of potential applications of Ecological Engineering (e.g. urban planning, urban hydrology, air quality issues, ecology of buildings...) seems to be neglected at UCB. It would be interesting to know why.

<b>URL</b>	<a href="http://www.ce.berkeley.edu/Programs/Environment/">http://www.ce.berkeley.edu/Programs/Environment/</a>
<b>Last update of site</b>	25 February 2000
<b>Undergrad studies</b>	No
<b>Graduate studies</b>	Yes
<b>Ph.D.</b>	Yes
<b>Financial support</b>	No information found

## 4. Improving Ecological Engineering Graduate Program at the U. of Maryland, USA ecosystems



The Department of Biological Resources Engineering (BRE) at the University of Maryland (UMd) sees Biological Resources Engineers as people that "improve societies, ecosystems, and the lives of individuals". They are "specializing in products made from, used with, or applied to living organisms, they engineer solutions to problems involving human health and safety, environmental quality, and sustainable food and fiber production".

Ecological Engineering is offered as part of the BRE program. It is open to engineering graduates from a variety of disciplines, and to nonengineering graduates (under certain conditions). The program follows a "multidisciplinary approach to problem solving", and integrates "field studies, basic research, modeling, product design, and system construction". Research includes **practical issues** such as "flood prevention using wetlands, restoration of damaged or degraded ecosystems, creation of new wildlife habitat, use of vegetation communities in waste water treatment, and use of sludge or other waste to restore degraded ecosystems".

The presentation on the web **does not mention social sciences** and **disregards ethical issues**. However, the program is flexible enough so that individual students will probably be able to include both issues on their own. There is a Graduate Ecological Engineering Society at UMd (however, with a rather outdated website...).

URL	<a href="http://www.agnr.umd.edu/users/bioreng/">http://www.agnr.umd.edu/users/bioreng/</a>
Last update of site	13 March 2000
Undergrad studies	No (Biological Resources Engineering offered)
Graduate studies	Yes
Ph.D.	Yes
Financial support	Assistantships and fellowships are available on a competitive basis

## 5. Habit of ethical conduct **Bio-Resource Engineering at the University of Maine, USA**



Bio-Resource engineers are defined on UMaine's website as "those people who apply information from the biological and physical sciences, the engineering sciences, engineering design, and social sciences and humanities to solve problems involving biological systems and natural resources". It is a declared goal of this program to "develop in the student a **sensitivity to socially related technical problems** (...) and the **habit of ethical conduct**". UMaine offers a Bachelor of Science degree, a non-thesis Masters of Engineering and graduate study opportunities.

In the undergrad curriculum - assessed in the figure on the left - science classes (e.g. chemistry, physics, biology, mathematics) and **engineering classes** (e.g. thermodynamics, applied mechanics, bioresource engineering...) form a balanced equilibrium with classes like "Fundamentals of Public Communication" and "General Education Electives". The curriculum is finished with a **two semester design project**. Students can concentrate on: 1) aquacultural engineering 2) biomedical engineering 3) bio-resource engineering 4) fluid power 5) food engineering 6) forest engineering 7) land and water resource engineering.

Compared to the other institutions assessed so far, **ecology** seems to play a minor role in this program.

The information available on their graduate program is much less comprehensive. Students can specialize in "engineering for biological process control, land and water resources engineering, food engineering, mechanization of aquaculture, harvesting and processing of marine species, use of biomass, and engineering of agricultural and forest production systems".

URL	<a href="http://www.engineering.umaine.edu/bre">http://www.engineering.umaine.edu/bre</a>
Last update of site	19 November 1999
Undergrad studies	Yes
Graduate studies	Yes

**Ph.D.** No information found

**Financial support** Several graduate assistantships available each year

## In the pipeline... **Planned programs**

According to the website of Texas A&M University, Ecological Engineering programs are currently being developed at 9 American universities, with several more being planned. Two of these deserve a further comment:

**The Ohio State University, USA**, academic home of William Mitsch, is developing a "new multidisciplinary academic program in ecological engineering", according to their publication "onCampus online" (Feb.25, 1999, Vol 28, No.15) and has been looking for staff (see EcoEng Newsletter 1/2000). Unfortunately, these efforts are not presented on the web.

**Texas A&M University Kingsville, USA**, is planning to "implement a formalized specialty area in Ecological Engineering by the year 2001". The driving force behind this new field is Dr. David Tilley, who recently graduated at the University of Florida. The information published on their website looks very promising. Potential course modules are covering a wide range of topics, including e.g. "Ecological Decision Sciences", "Complex Systems Design under Ecological Constraints", "Ecological Engineering Ethics"

In Germany the **Technical University of Munich at Weihenstephan** is currently developing an Ecological Engineering program at the chair of vegetation ecology (Prof. Jörg Pfadenhauer). It will probably focus on the major research themes of the chair of vegetation ecology, which are: Agriculture Ecology, Wetlands, Restoration Ecology, and Population Biology.

The EcoEng Newsletter will report on these programs as soon as more information is available.

## What else is out there? **Some more findings**

A number of other institutions are offering courses in Ecological Engineering but do not seem to offer programs. These are:

- The **Lincoln University at Canterbury, New Zealand**, (home of the next Ecological Engineering conference in 2001) offers Ecological Engineering I & II lectures as part of "Advanced Human Ecology"
- The **School of Civic Engineering and Environment at the University of Western Sydney, Australia** offers an Ecological Engineering course.
- The **Department of Civil Engineering at Tokohu University, Japan**, is active in Ecological Engineering and seems to educate students. However, the information available in English does not allow any assessment.
- The same holds true for **Toyohashi University in Japan**. This school even has a Department of Ecological Engineering.

## Conclusion **What can we learn from this websearch?**

1. Ecological Engineering (EE) is an "emerging field" and an emerging market for universities. This is reflected by the growing number of schools that offer it as a program.
2. The institutions I visited (virtually) differ in their approach and in their vision of EE. The importance to integrate social sciences is not seen everywhere. Ethical and value issues are not addressed in most of the cases. Interestingly, the Bio-Resources program of UMaine was the only exception here.
3. Ecological Engineering has to compete with Bio-Resource Engineering (BRE) for students. On a quick glance, the difference between the two is hardly detectable: EE seems to have a stronger ecological and ethical approach ("the benefit of both"), whereas BRE seems to be more prone to simply utilize nature as resource,

however sustainably (whatever this means). Another difference in the USA is, that BRE is already accredited whereas EE is not.

4. The websites I visited differed wildly in quality and available information. I'd like to stress, that the internet is a very valuable resource for schools that should not be neglected!

### **Disclaimer**

This article is an attempt to summarize the available information on education programs in Ecological Engineering on the web. It is of course heavily biased:

- I had no access to information available in other languages than English or German, particularly not to information in Japanese, Chinese or other asiatic languages.
- The search engines I have chose have a focus on websites in Europe, North America and Australia.
- Some institutions, particularly in India or China, may not yet have a website.

**If you feel that your institutions is missing or misrepresented, contact me. You may possibly present it in one of the next issues of the EcoEng Newsletter.**

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### **How the data for this article were compiled**

I used four common search engines (Fast: <http://www.alltheweb.com>, Google: <http://www.google.com>, Alta Vista: <http://www.altavista.com>, Yahoo: <http://www.yahoo.com>). I looked for "ecological engineering" and "ecological engineering education" and browsed through the first 50-100 of the sometimes more than 10'000 matches I got. I also followed the links in linklists given in interesting websites. I consider this similar to how potential students would proceed.

### **References**

Mitsch, W.J., 1996, Ecological Engineering: The Roots and rationale of a New Ecological Paradigm, in: Etnier, C., Guterstam, B., Ecological Engineering for Wastewater Treatment, Lewis Publishers

Bergen, S.D., Bolton, S.M., Fridley, J.L., 1997, Ecological Engineering: Design based on Ecological Principles. Presented at the 1997 Annual ASAE Meeting, August 10-14, Paper No. 975035 (reference from Texas A&M website)

### **Websites used for this article**

Fachhochschule Magdeburg, Germany: <http://www.fh-magdeburg.de/studium/moegl/stgioe.htm>

Lincoln University at Canterbury, New Zealand: <http://kauri.lincoln.ac.nz>

Texas A&M University Kingsville, USA: <http://www.even.tamuk.edu/ecoengr/>

Tokohu University, Japan: <http://www.civil.tohoku.ac.jp/english/chiiki/chiiki.html>

Toyohashi University in Japan: <http://ita.tutkie.tut.ac.jp/anbo/www/english/8keiE.html>

University of California, Berkeley, USA: <http://www.ce.berkeley.edu/Programs/Environment/>

University of Florida, USA: <http://www.enveng.ufl.edu/homepp/brown/syseco/default.htm>

University of Maine, USA: <http://www.engineering.umaine.edu/br>

University of Maryland, USA: <http://www.agnr.umd.edu/users/bioreng/>

University of Western Sydney, Nepean, Australia: <http://www4.eng.nepean.uws.edu.au/ce/>

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