

# MICHIGAN STATE UNIVERSITY

February 16, 2011

## MEMORANDUM

TO: Dr. Douglas Estry, Associate Provost for Undergraduate Education  
and Dean of Undergraduate Studies

FROM: Dr. Linda O. Stanford, Associate Provost for Academic Services

RE: Request for a New Bachelor of Science Degree in Environmental  
Engineering

For Transmittal to the University Committee on Academic Policy UCAP)

The request referenced above is being sent to the University Committee on Academic Policy (UCAP) in accordance with the *Bylaws for Academic Governance*, 4.4.

### UCAP Response Requested:

Please ask the UCAP to consider the request referenced above and provide consultative commentary. Please mail the related materials referenced under the heading Attachments at the end of this memorandum to the UCAP members.

After receiving UCAP's consultative response, the Provost will make a determination to forward or not to forward the request to the University Committee on Curriculum for its approval of curriculum and degree requirements.

If you have any questions, please call Joy Speas, University Curriculum Administrator, at 5-8420.

Thank you.

### Attachments:

1. Request to Establish a New Academic Program form dated January 5, 2011: Bachelor of Science Degree in Environmental Engineering and attachments.



### University Curriculum and Catalog

176 Administration Bldg.  
East Lansing, MI  
48824-1046

517-355-8420  
Fax: 517-353-1935

s:\share\lucapenebs

## COLLEGE OF ENGINEERING

1. Request to establish a **Bachelor of Science** degree in **Environmental Engineering** in the Department of Civil and Environmental Engineering. The University Committee on Academic Policy (UCAP) will consider this request.

- a. **Background Information:**

The Department of Civil and Environmental Engineering has offered a well-established concentration in environmental engineering for nearly twenty years through the existent Bachelor of Science degree in Civil Engineering. The environmental engineering field has matured to the point where the undergraduate degree is becoming the norm. The American Academy of Environmental Engineers have developed a body of knowledge appropriate for an undergraduate degree in environmental engineering. There is clearly a need in the State of Michigan for the degree and there is renewed interest in and funding for water and wastewater infrastructure and environmental protection. Michigan State University is a leader in the broadly defined area of environmental science and engineering. The program will be accredited under the Accreditation Board for Engineering and Technology (ABET).

- b. **Academic Programs Catalog Text:**

The environmental engineering major is designed to provide students with the engineering and scientific principles to analyze, design, and manage environmental systems, including water supplies, wastewater treatment facilities, air pollution control systems, surface and groundwater resources, and landfills. The program offers a thorough background in engineering fundamentals, along with a broad understanding of mathematical, physical, chemical, and biological concepts as they relate to environmental engineering.

The Bachelor of Science Degree program in Environmental Engineering is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012; telephone 1-410-347-7700.

### **Requirements for the Bachelor of Science Degree in Environmental Engineering**

1. The University requirements for bachelor's degrees as described in the *Undergraduate Education* section of this catalog; 128 credits, including general elective credits, are required for the Bachelor of Science degree in Environmental Engineering.

The University's Tier II writing requirement for the Environmental Engineering major is met by completing Civil Engineering 321. That course is referenced in item 3. a. below.

Students who are enrolled in the College of Engineering may complete the alternative track to Integrative Studies in Biological and Physical Sciences that is described in item 1. under the heading *Graduation Requirements for All Majors* in the College statement. Certain courses referenced in requirement 3. below may be used to satisfy the alternative track.

2. The requirements of the College of Engineering for the Bachelor of Science degree.

The credits earned in certain courses referenced in requirement 3. below may be counted toward College requirements as appropriate.

3. The following requirements for the major.

- a. All of the following courses (47 credits):

			CREDITS
BS	161	Cell and Molecular Biology	3
BS	162	Organismal and Population Biology	3
CE	221	Statics	3
CE	271	Introduction to Civil and Environmental Engineering	4
CE	272	Civil and Environmental Engineering Analysis	3
CE	321	Introduction to Fluid Mechanics	4
CE	495	Senior Design in Civil and Environmental Engineering	4
CEM	161	Chemistry Laboratory I	1

	CHE	201	Materials and Energy Balances	3
	ENE	280	Principles of Environmental Engineering and Science	3
	ENE	421	Engineering Hydrology	3
	ENE	480	Environmental Measurements Laboratory	1
	ENE	481	Environmental Chemistry: Equilibrium Concepts	3
	ENE	483	Water and Wastewater Engineering	3
	ENE	487	Microbiology for Environmental Science and Engineering	3
	ENE	489	Air Pollution: Science and Engineering	3
b.	One of the following courses (3 or 4 credits):			
	CHE	321	Thermodynamics for Chemical Engineering	4
	ME	201	Thermodynamics	3
c.	One of the following courses (3 or 4 credits):			
	GLG	201	The Dynamic Earth	4
	GLG	301	Geology of the Great Lakes Region	3
d.	<b>Major Tracks.</b> Complete 12 to 18 credits of electives as specified below.			
	<b>Geo-environmental Engineering Track</b>			
	All of the following courses (18 credits):			
	CE	312	Soil Mechanics	4
	CE	337	Civil Engineering Materials I	4
	CE	418	Geotechnical Engineering	3
	CE	485	Landfill Design	3
	ME	222	Mechanics of Deformable Solids	4
	<b>Water Resources Track</b>			
	All of the following courses (13 credits):			
	ENE	422	Applied Hydraulics	3
	GLG	411	Hydrogeology	3
	GLG	412	Glacial Geology and the Record of Climate Change	4
	GLG	421	Environmental Geochemistry	3
	<b>General Track</b>			
	1.	At least one of the following courses (3 to 6 credits):		
		CE	485 Landfill Design	3
		ENE	422 Applied Hydraulics	3
	2.	Additional credits in technical courses at the 300-level or above approved by the department to total 12 credits in the track. Courses selected should provide some focus related to an application area of environmental engineering.		

Effective Fall 2011.

<b>View a Program</b>		<b>Main Menu</b>
Joy Speas, RO	Wednesday, 1/5/2011	
<b>Program Name: Environmental Engineering</b> <b>Degree: BS Sequence Number: 1</b>	Program Request ID: 1450	
<b>Effective Dates: Fall 2010 - Open Status: Interim Initial Action: New</b>		
<b>Requested Date: 3/27/2009 1:45:03 PM</b>		
<p><b>1. Department/School/College:</b> 16148 .... Department of Civil and Environmental Engineering</p> <p><b>2. Name of Program:</b> Environmental Engineering</p> <p><b>3. Name of Degree:</b> BS</p> <p><b>4. Type of Program:</b> Major</p> <p><b>5. Effective Start Semester:</b> Fall <del>2010</del> 2011</p> <p><b>6. Target student audience for the program:</b> College of Engineering Students</p> <p><b>7. Enrollment:</b> <b>What is the expected enrollment per year:</b> 25 <b>What is the minimum enrollment acceptable:</b> 10</p> <p><b>8. Source of budget for the program:</b> To align academic planning and curricular change, ALL requests for NEW funds must be included in the College's annual planning letter. Provost approval of new funds and the effective date for the new program must align. If funding is not approved, then the program request will not be forwarded to Academic Council.  Internal reallocation  If new funds, was this request included in the College's annual planning letter? Indicate yes or no. If no, then this is a department or college fund reallocation (If the program is implemented, no additional resources are required.).</p> <p><b>9. Projected Costs as compared to other programs in unit:</b> Same</p> <p><b>10. Staff requirement:</b> How many additional staff will be required: 0  Who will provide the primary instruction. Describe any external linkages(industry, government, etc.):</p>		

Faculty already in the Department of Civil and Environmental Engineering

**11. Will additional equipment be required:**

Approximate cost: 0

Source of funding:

**12. Will additional library materials be required:**

Approximate cost: 0

Source of funding: Use of existing materials in the library

**13. Will additional space be required:**

Type:

Approximate amount:

**14. If the program requirements contain a named concentration, do you wish for the concentration to be noted on the student's transcript?:**

No

**15. Detailed Description:**

*a. Background Information...*

*1. Considerations that precipitated the development of the program:*

- The Department of Civil and Environmental Engineering has 10 faculty members in environmental engineering and water resources, so the teaching resources are available.
- The environmental engineering concentration within CEE is well-established and almost 20 years-old. It has developed from the Sanitary Engineering B.S. Degree program, which was offered in the 1940s.
- The environmental engineering field has matured to the point where the undergraduate degree is becoming well-established and the norm.
- The American Academy of Environmental Engineers has developed a Body of Knowledge for the undergraduate degree.
- There is only one other undergraduate environmental engineering program in the state of Michigan (at Michigan Tech), so there is clearly a need in a time where there is renewed interest and funding for water and wastewater infrastructure and environmental protection.

2. The program will be accredited under ABET. The criteria are listed on the ABET website (page 12). The criteria have also been included in an Appendix.

*b. Rationale for offering the program at MSU.*

- MSU is a leader in the broadly defined area of environmental science and engineering.
- Environmental engineering programs traditionally had a much higher enrollment by female students<sup>[1]</sup>[1] [2].

[1] [www.nsf.gov/attachments/104206/public/Final\\_Workforce.doc](http://www.nsf.gov/attachments/104206/public/Final_Workforce.doc)

[2] [http://www.nsf.gov/statistics/nsf07307/content.cfm?pub\\_id=3634&id=2](http://www.nsf.gov/statistics/nsf07307/content.cfm?pub_id=3634&id=2)

- Establishing a B.S. environmental engineering program at MSU will help increase the number of women engineering students in the College of Engineering.
- Data indicate a market for the degree.

*c. Rationale for the program being housed in the primary administrative unit.*

- The environmental engineering concentration within CEE is well-established and almost 20 years-old. It has developed from the Sanitary Engineering B.S. Degree program, which was offered in the 1940s. The department currently offers MS & PhD degrees in environmental engineering- the BS is a logical extension.

*d. Educational objectives of the program and their relationship to those of the college and the University.*

A set of Program Educational Outcomes (PEOs) has been developed as part of the ABET evaluation process.

The Department of Civil and Environmental Engineering provides opportunities to obtain the knowledge, skills and professional perspective needed for:

- entry to civil engineering practice and the pursuit of advanced studies;
- life-long learning;
- continuing professional development and leadership; and
- licensure; all leading to career success.

The undergraduate curriculum, courses, organizations and activities prepare graduates to:

- apply mathematics, science and contemporary methods to the formulation and solution of engineering problems, specific to environmental engineering;
- specify and conduct standard laboratory analyses, interpret data, formulate recommendations based on test results, and build understanding through experimentation, in three matrices: air, soil, and water;
- design systems, components and processes that conform to specifications and produce the intended benefits;
- communicate effectively in writing and speech;
- employ interpersonal and social skills required for working on a team, in an organization, and with the general public;
- honor professional ethics;
- respect societal and environmental impacts of engineering; and
- understand contemporary issues in engineering practice.

These educational objectives are promoted and supported by a departmental community of students, faculty and staff characterized by integrity and by respect for individuals, society, the environment, the engineering profession, and engineering education and institutions.

*e. Faculty who were instrumental in developing the program and faculty who will be*

*responsible for implementing the program (see item 10).*

ENE Faculty within CEE. Dr. Masten has taken the lead and has agreed to continue to do so. Drs Harichandran (CEE Chairperson), Tom Voice (Director of Environmental Engineering Program), and Richard Lyles (CEE Associate Chairperson) are also involved.

*f. Plan for evaluating the program. Plan for assessing student outcomes.*

The program will be evaluated on a continuing basis as part of the ABET review process. This will be done in parallel with the existing and well-established ABET accreditation process in civil engineering.

*g. Program description including statement and specific requirements of the program as they will appear in the University catalog*

The environmental engineering major is designed to prepare students with the engineering and scientific principles to analyze, design, and manage environmental systems, including water supplies, wastewater treatment facilities, air pollution control systems, surface and groundwater resources, and landfills. The program provides a thorough background in engineering fundamentals, along with a broad understanding of mathematical, physical, chemical, and biological concepts as they relate to environmental engineering.

*Specific Requirements:*

The environmental engineering major is designed to prepare students with the engineering and scientific principles to analyze, design, and manage environmental systems, including water supplies, wastewater treatment facilities, air pollution control systems, surface and groundwater resources, and landfills.

The bachelor's degree program provides a thorough background in engineering fundamentals, along with a broad understanding of mathematical, physical, chemical, and biological concepts as they relate to environmental engineering. Students have the choice of two concentrations: Geoenvironmental Engineering and Water Resources.

### **Environmental Engineering**

#### **Requirements for the Bachelor of Science Degree in Environmental Engineering**

1. The University requirements for bachelor's degrees as described in the Undergraduate Education section of this catalog; 128 credits, including general elective credits, are required for the Bachelor of Science degree in Environmental Engineering.

The University's Tier II writing requirement for the Environmental Engineering major is met by completing Civil Engineering 321. This course is referenced in item 3. a. below.

Students who are enrolled in the College of Engineering may complete the alternative track to Integrative Studies in Biological and Physical Sciences that is described in item 1. under the heading **Graduation Requirements for All Majors** in the College statement. Certain courses referenced in requirement 3. below may be used to satisfy the alternative track.

2. The requirements of the College of Engineering for the Bachelor of Science degree.

The credits earned in certain courses referenced in requirement 3 below may be counted toward College requirements as appropriate.

3. The following requirements for the major:

- a. All of the following courses (47 credits):

BS 161 ~~Principles of Biology: Cells and Molecules~~ *Cells and Molecular Biology*

3

		<i>Organismal and Population Biology</i>	
BS	162	<del>Principles of Biology: Organisms and Populations</del>	3
CE	221	Statics	3
CE	271	Introduction to Civil and Environmental Engineering	4
CE	272	Civil and Environmental Engineering Analysis	3
CE	321	Introduction <del>of</del> Fluid Mechanics	4
CE	495	Senior Design in Civil & Environmental Engineering	4
CEM	161	Chemistry Laboratory I	1
CHE	201	Materials and Energy Balances	3
ENE	280	Principles of Environmental Engineering and Science	3
ENE	421	Engineering Hydrology	3
ENE	480	Environmental Measurements Laboratory	1
ENE	481	Environmental Chemistry: Equilibrium Concepts	3
ENE	483	Water and Wastewater Engineering	3
ENE	487	Microbiology for Environmental Science and Engineering	3
ENE	489	Air Pollution: Science and Engineering	3
b. Complete one of the following (3-4 credits):			
CHE	321	Thermodynamics for Chem <sup>ical</sup> Engineering	4
ME	201	Thermodynamics	3
c. Complete one of the following (3-4 credits);			
	GLG 201	The Dynamic Earth	4
	GLG 301	Geology of the Great Lakes Region	3
d. Major Tracks. Complete 12-18 credits of electives as specified below.			
Geo-environmental Engineering Track			
1	All of the following courses (18)		
	CE	312 Soil Mechanics	4
	CE	337 <del>CE</del> Materials I <i>Civil Engineering</i>	4
	CE	418 Geotechnical Engineering	3
	CE	485 Landfill Design	3
	ME	222 Mechanics of Deformable Solids	4
Water Resources Track <i>13</i>			
1	All of the following courses ( <i>12</i> ):		
	ENE	422 Applied Hydraulics	3
	GLG	411 Hydrogeology	3
	GLG	412 Glacial Geology and the Record of Climate Change	<i>3 4</i>
	GLG	421 Environmental Geochemistry	3
General Track			
1	At least one of the following courses (3):		
	CE	485 Landfill Design	3
	ENE	422 Applied Hydraulics	3



- 2 Additional credits to total 12 in the track, from technical courses at the 300 level or above, approved by the Department. Courses should be selected to provide some focus related to an application area of environmental engineering.

h. If the program will be offered in a location other than the main campus in East Lansing,

specify the location (s).

N/A

i. List the name and describe any certificate program that is associated with a new or extant degree program.

– Explain the relationship between the certificate program and a new or extant degree program.

– If a certificate program is being proposed that is to related to a degree program, please explain how the department/school/college will learn that the supervising faculty have endorsed the potential certificate holders as possessing specified skills or competency levels that render them eligible to receive the certificate and the degree.

N/A

j. Other information that will assist the Provost and the University-level committees in evaluating the request.

N/A

16. Cooperating Department(S)/School(s)/College(s):

College of Engineering

Department of Chemical Engineering & Materials Science

Department of Mechanical Engineering

College of Natural Science

Biological Science - Interdepartmental

Department of Chemistry

Department of Geological Sciences

Department of Mathematics

Department of Physics and Astronomy

#### 16. Are there admissions requirements for this program?:

Grade or grade-point average requirements and if so in which course(s), portfolio requirement, audition, essay, etc. If there are not admission requirements other than those required by the University policy indicate "none".

Same as other programs in the College of Engineering.

#### DEPARTMENT LEVEL APPROVAL STATUS

Approved: Department of Civil and Environmental Engineering  
12/21/2010 4:35:29 PM by Mary Mroz for Ronald Harichandran, Chairperson

#### SIGNOFFS STATUS

No Response by: College of Natural Science

Signed Off: Department of Chemistry  
12/22/2010 8:36:49 AM by Steven Poulos for John McCracken, Chairperson

Signed Off: Department of Geological Sciences  
12/23/2010 8:15:07 AM by Jackie Bennett for David W. Hyndman, Chairperson

Comments: Geological Sciences approves

Signed Off: Department of Mathematics  
12/21/2010 6:06:22 PM by Pavel Sikorskii for Yang Wang, Chairperson

Signed Off: Department of Physics and Astronomy  
12/21/2010 7:32:28 PM by Wolfgang Bauer for Wolfgang Bauer, Chairperson

#### **COLLEGE LEVEL APPROVAL STATUS**

Approved: College of Engineering  
1/5/2011 10:09:25 AM by Jamie Ramos for Thomas F. Wolff, Associate Dean

Comments: Approved with three minor corrections: 1. Should read Fall 2011 NOT Fall 2010 2. ENE 483 should be Unit Operations and Processes in Environmental Engineering NOT Water and Wastewater Engineering 3. GLG 412 should be 4 credits NOT 3 with the total credits from the Water Resources Track being 13 NOT 12

# DEPARTMENT of CIVIL and ENVIRONMENTAL ENGINEERING

Ronald S. Harichandran, Chairperson

## UNDERGRADUATE PROGRAM S

## CIVIL ENGINEERING

The civil engineering major is designed to provide graduates with a broad understanding of the physical factors involved in the planning, design, and operation of public and private facilities.

The bachelor's degree program in civil engineering is oriented to the application of engineering principles to several areas of specialization, including transportation, structures, geotechnical engineering, environmental engineering, water resources, and pavements and materials. ~~An Environmental Engineering concentration is available as an elective to students in the program.~~

The Bachelor of Science Degree program in Civil Engineering is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012; telephone 1-410-347-7700.

### Requirements for the Bachelor of Science Degree in Civil Engineering

1. The University requirements for bachelor's degrees as described in the *Undergraduate Education* section of this catalog; 128 credits, including general elective credits, are required for the Bachelor of Science degree in Civil Engineering.

The University's Tier II writing requirement for the Civil Engineering major is met by completing Civil Engineering 321 and 341. ~~The University's Tier II writing requirement for students who elect the Environmental Engineering concentration is met by completing Civil Engineering 324.~~ Those courses are referenced in item 3. a. below.

Students who are enrolled in the College of Engineering may complete the alternative track to Integrative Studies in Biological and Physical Sciences that is described in item 1. under the heading **Graduation Requirements for All Majors** in the College statement. Certain courses referenced in requirement 3. below may be used to satisfy the alternative track.

2. The requirements of the College of Engineering for the Bachelor of Science degree. The credits earned in certain courses referenced in requirement 3. below may be counted toward College requirements as appropriate.

3. The following requirements for the major:

CREDITS 43

- a. All of the following courses:
- |     |     |                                   |   |   |
|-----|-----|-----------------------------------|---|---|
| CE  | 221 | Statics                           | 3   |   |
| CE  | 271 | Introduction to Civil Engineering | 4   |   |
| ENE | CE  | 280                               | Principles of Environmental Engineering and Science | 3 |
|     | CE  | 305                               | Introduction to Structural Analysis and Design      | 3 |
|     | CE  | 312                               | Soil Mechanics                                      | 4 |
|     | CE  | 321                               | Introduction to Fluid Mechanics                     | 4 |
|     | CE  | 337                               | Civil Engineering Materials I                       | 4 |
|     | CE  | 341                               | Transportation Engineering                          | 3 |
|     | CE  | 495                               | Senior Design in Civil Engineering                  | 4 |
|     | CEM | 161                               | Chemistry Laboratory I                              | 1 |
|     | ME  | 222                               | Mechanics of Deformable Solids                      | 4 |
|     | ST  | 351                               | Probability and Statistics for Engineering          | 3 |
- and Environmental*
- CE 272 Civil and Environmental Engineering Analysis 3*
- and Environmental*
- GLG 301 Geology of the Great Lakes Region 3*
- ~~Students who complete the Environmental Engineering concentration do not have to complete Civil Engineering 337, 341, 461, or Mechanical Engineering 364.~~
- b. One of the following courses: 3
- |    |     |  |   |
|----|-----|--|---|
| CE | 461 | Computational Methods in Civil Engineering | 3 |
| ME | 361 | Dynamics                                   | 3 |
- c. One of the following courses: 3
- |     |     |   |   |
|-----|-----|---|---|
| BE  | 351 | Thermodynamics for Biological Engineering | 3 |
| ECE | 345 | Electronic Instrumentation and Systems    | 3 |
| ME  | 201 | Thermodynamics                            | 3 |
| MSE | 250 | Materials Science and Engineering         | 3 |
- ~~Students who complete the Environmental Engineering concentration do not have to complete this requirement.~~
- d. Major Tracks. Complete 18 credits of electives as specified below. At least 9 credits of one track must be completed as specified. The additional 9 credits must include courses from three different tracks. Construction Engineering and Management courses may count towards the additional 9 credits.
- Environmental Track**
1. Both of the following courses:

<del>ENE</del>	<del>CE</del>	481	Environmental Chemistry: Equilibrium Concepts	3	<i>Water and Wastewater Engineering</i>
<del>ENE</del>	<del>CE</del>	483	Unit Operations and Processes in Environmental Engineering	3	
		2.	One of the following courses:		
<del>ENE</del>	<del>CE</del>	421	Engineering Hydrology	3	
	CE	485	Landfill Design	3	
<del>ENE</del>	<del>CE</del>	487	Microbiology for Environmental Science and Engineering	3	<i>EVE 489 Air Pollution: Science and Engineering 3</i>
<b>Geotechnical Track</b>					
		1.	Both of the following courses:		
	CE	418	Geotechnical Engineering	3	
	CE	485	Landfill Design	3	
		2.	One of the following courses:		
	CE	431	Pavement Design and Analysis I	3	
	CE	815	Selected Topics in Geotechnical Engineering	3	
	CE	818	Advanced Geotechnical Design	3	
<b>Pavements Track</b>					
		1.	Both of the following courses:		
	CE	431	Pavement Design and Analysis I	3	
	CE	432	Pavement Rehabilitation	3	
		2.	One of the following courses:		
	CE	418	Geotechnical Engineering	3	
	CE	831	Advanced Concrete Pavement Analysis and Design	3	
	CE	832	Advanced Asphalt Pavement Analysis and Design	3	
<b>Structures Track</b>					
		1.	Both of the following courses:		
	CE	405	Design of Steel Structures	3	
	CE	406	Design of Concrete Structures	3	
		2.	One of the following courses:		
	CE	400	Structural Mechanics	3	
	CE	805	Advanced Design of Steel Structures	3	
	CE	806	Advanced Structural Concrete Design	3	
<b>Transportation Track</b>					
		1.	Both of the following courses:		
	CE	448	Transportation Planning	3	
	CE	449	Highway Design	3	
		2.	One of the following courses:		
	CE	431	Pavement Design and Analysis I	3	
	CE	432	Pavement Rehabilitation	3	
	CE	444	Principles of Traffic Engineering	3	
<b>Water Resources Track</b>					
		1.	Both of the following courses:		
<del>ENE</del>	<del>CE</del>	421	Engineering Hydrology	3	
<del>ENE</del>	<del>CE</del>	422	Applied Hydraulics	3	
		2.	One of the following courses:		
<del>ENE</del>	<del>CE</del>	423	Applied Hydrologic Analysis and Design	3	
<del>ENE</del>	<del>CE</del>	822	Groundwater Modeling	3	
	GLG	411	Hydrogeology	3	
	GLG	412	Glacial Geology and the Record of Climate Change	4	
<b>General Track.</b> Students may choose a general track in fulfillment of the Major Track requirement. Students must complete 12 credits from among four different tracks above. Students must also complete 6 additional credits across all tracks which may include course work from Construction Engineering and Management courses below.					
<b>Construction Engineering and Management Courses</b>					
	CE	471	Construction Engineering-Equipment, Methods and Planning	3	
	CMP	411	Construction Project Scheduling	3	
	CMP	415	Cost Estimating Analysis	3	
	CMP	423	Construction Project Management	3	

*Insert ①*

**Environmental Engineering Concentration**

The environmental engineering concentration is available to students who are enrolled in the Bachelor of Science degree program in civil engineering. Students who elect this concentration must complete the following courses. The concentration will be noted on the student's transcript.

	CREDITS
1. All of the following courses:	23
CE 480 Environmental Measurements Laboratory	1
CE 481 Environmental Chemistry: Equilibrium Concepts	3
CE 483 Unit Operations and Processes in Environmental Engineering	3
CE 485 Landfill Design	3
CE 487 Microbiology for Environmental Science Engineering	3
CEM 151 General and Descriptive Chemistry	4
CEM 152 Principles of Chemistry	3
CHE 201 Material and Energy Balances	3
Civil Engineering 481, 483 and 485 may be used to satisfy both the requirement for the Environmental Engineering concentration and 9 credits of the track requirements for the Bachelor of Science in Civil Engineering.	
2. One of the following courses:	3 or 4
BE 351 Thermodynamics for Biological Engineering	3
CHE 321 Thermodynamics for Chemical Engineering	4
ME 201 Thermodynamics	3

**ENVIRONMENTAL ENGINEERING**

The environmental engineering major is designed to provide students with the engineering and scientific principles to analyze, design, and manage environmental systems, including water supplies, wastewater treatment facilities, air pollution control systems, surface and groundwater resources, and landfills. The program offers a thorough background in engineering fundamentals, along with a broad understanding of mathematical, physical, chemical, and biological concepts as they relate to environmental engineering.

The Bachelor of Science Degree program in Environmental Engineering is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012; telephone 1-410-347-7700.

**Requirements for the Bachelor of Science Degree in Environmental Engineering**

1. The University requirements for bachelor's degrees as described in the *Undergraduate Education* section of this catalog; 128 credits, including general elective credits, are required for the Bachelor of Science degree in Environmental Engineering.  
 The University's Tier II writing requirement for the Environmental Engineering major is met by completing Civil Engineering 321. That course is referenced in item 3. a. below.  
 Students who are enrolled in the College of Engineering may complete the alternative track to Integrative Studies in Biological and Physical Sciences that is described in item 1. under the heading *Graduation Requirements for All Majors* in the College statement. Certain courses referenced in requirement 3. below may be used to satisfy the alternative track.
2. The requirements of the College of Engineering for the Bachelor of Science degree.  
 The credits earned in certain courses referenced in requirement 3. below may be counted toward College requirements as appropriate.
3. The following requirements for the major.

**CREDITS**

- a. All of the following courses (47 credits):
 

BS	161	Cell and Molecular Biology	3
BS	162	Organismal and Population Biology	3
CE	221	Statics	3
CE	271	Introduction to Civil and Environmental Engineering	4
CE	272	Civil and Environmental Engineering Analysis	3
CE	321	Introduction to Fluid Mechanics	4
CE	495	Senior Design in Civil and Environmental Engineering	4
CEM	161	Chemistry Laboratory I	1
CHE	201	Materials and Energy Balances	3
ENE	280	Principles of Environmental Engineering and Science	3
ENE	421	Engineering Hydrology	3
ENE	480	Environmental Measurements Laboratory	1
ENE	481	Environmental Chemistry: Equilibrium Concepts	3
ENE	483	Water and Wastewater Engineering	3
ENE	487	Microbiology for Environmental Science and Engineering	3
ENE	489	Air Pollution: Science and Engineering	3
- b. One of the following courses (3 or 4 credits):
 

CHE	321	Thermodynamics for Chemical Engineering	4
ME	201	Thermodynamics	3
- c. One of the following courses (3 or 4 credits):
 

GLG	201	The Dynamic Earth	4
GLG	301	Geology of the Great Lakes Region	3
- d. **Major Tracks.** Complete 12 to 18 credits of electives as specified below.  
**Geo-environmental Engineering Track**

All of the following courses (18 credits):

CE	312	Soil Mechanics	4
CE	337	Civil Engineering Materials I	4
CE	418	Geotechnical Engineering	3
CE	485	Landfill Design	3
ME	222	Mechanics of Deformable Solids	4

**Water Resources Track**

All of the following courses (13 credits):

ENE	422	Applied Hydraulics	3
GLG	411	Hydrogeology	3
GLG	412	Glacial Geology and the Record of Climate Change	4
GLG	421	Environmental Geochemistry	3

**General Track**

1. At least one of the following courses (3 to 6 credits):

CE	485	Landfill Design	3
ENE	422	Applied Hydraulics	3
2. Additional credits in technical courses at the 300-level or above approved by the department to total 12 credits in the track. Courses selected should provide some focus related to an application area of environmental engineering.

Biosystems Engineering 351 and Mechanical Engineering 201 may be used to satisfy both the requirements for the Environmental Engineering concentration and the requirements for the Bachelor of Science in Civil Engineering.

3. One of the following courses: ..... 3  
CE 421 Engineering Hydrology ..... 3  
CE 422 Applied Hydraulics ..... 3  
These courses may be used to satisfy both the requirements for the Environmental Engineering concentration and 3 credits of the track requirement for the Bachelor of Science in Civil Engineering.
4. One of the following courses: ..... 3 or 4  
CE 337 Civil Engineering Materials I ..... 4  
CE 341 Transportation Engineering ..... 3  
CE 461 Computational Methods in Civil Engineering ..... 3  
CEM 251 Organic Chemistry I ..... 3  
CEM 351 Organic Chemistry I ..... 3  
ME 361 Dynamics ..... 3
5. Major Tracks. Complete 6 credits from two tracks in the major as described above.