

2 Year MS & MSE Plan		Requirement*	Notes	Course #	Credits	Term			
Engineering	Civil Engineering Core	15CR from the Civil and Environmental Engineering Department	Required: CEE 520 CEE 521 CEE 522	CEE 520					
				CEE 521					
				CEE 522					
		Minimum of 2 additional CEE courses in Environmental and Water Resource Engineering	See List A for sample of approved courses (next page)						
School for Environment and Sustainability	SS CORE	6CR in Systems Analysis for Sustainability	Required: EAS 557/CEE 586 And one course from List A1	EAS 557					
				9CR total	Sustainable Design & Technology Minimum 3CR	Required: See List A2 for acceptable courses			
					Sustainable Enterprise Minimum 3CR	See List A3 for acceptable courses			
			Additional 3CR minimum from list A1, 2, or 3	See attached list (A1-3) of acceptable courses in these specializations					
	EAS Core	EAS 509 EAS 510	IAMS Requirement Two courses; 3CR minimum Please see page 3 for approved courses.						
	Analytics	3CR in Analytics	EAS 538 or equivalent required:						
	Opus*	Students are <u>not</u> expected to complete an Opus, but could petition to do a thesis/practicum or project*	At most 6CR of EAS 700/701						
Cognates [Rackham requirement]		Please see next page for cognate requirement information							
TOTALS	MINIMUM CREDIT HOURS BY SCHOOL	"EAS" – Minimum 25CR							
		"CEE" – Minimum 15CR							
	TOTAL CREDIT HOURS	Minimum 54 Credit Hours							

\*Any waiver or substitution of degree requirement must be approved by the appropriate faculty and submitted to OAP

## Civil Engineering

Sample of Environmental and Water Resource courses (more available, see advisor):

CEE 524 (3)	Environmental Turbulence (W)
CEE 580 (3)	Physicochemical Processes in Environmental Engineering (W)
CEE 581 (3)	Aquatic Chemistry (W)
CEE 582 (3)	Environmental Microbiology (F)
CEE 586/EAS 557 (3)	Industrial Ecology (W)
CEE 624 (3)	Restoration Fundamentals and Practice in Aquatic Systems (F)

### A) Sustainable Systems Core (1-3)

#### 1) Systems Analysis for Sustainability (at least 6CR\*)

EAS 573 (3cr)	Environ Footprinting and Environ Input- Output Analysis(W)
EAS 597 (3cr)	Environmental Systems Analysis (F)
EAS 610 (1.5cr)	Advanced LCA Methods & Software Tools (W)
EAS 557/CEE 586 (3cr)	Industrial Ecology (W)
EAS 550/STRAT 566 (3cr)	Systems Thinking for Sustainable Development (W)

\*At least two courses need to be from the courses listed above

EAS 570 (3cr)	Environ Economics: Quantitative Methods & Tools (F)
EAS 501 (1.5cr)	Five courses on selected topics in Env. Economics (TBD)
EAS 531 (4cr)	Principles of GIS (F&W)

#### 2) Sustainable Design & Technology (3CR)

EAS 537 (3cr)	Urban Sustainability (F)
EAS 501.087 (3CR)	Technology and Community Sustainable Development (W)
EAS 615 (3CR)	Renewable Electricity and the Grid (W)
EAS 574/PUBPOL 519 (3cr)	Sustainable Energy Systems (F)
EAS 548 (3cr)	Land Use and Global Change (F)
EAS 605/BA 605 (3cr)	Green Development (W)
EAS 687 (4cr)	Landscape Planning (F)
ARCH 575 (3cr)	Building Ecology (F)
CEE 460 (3cr)	Design of Environ Engineering Systems (F)
CEE 582 (3cr)	Environmental Microbiology (F)
CEE 686/ChE 686 (2-3cr)	Case Studies in Environ Sustainability (W)
MECHENG 589 (3cr)	Sustainable Design of Technology Systems (F)

#### 3) Sustainable Enterprise (3CR)

EAS 530 (3cr)	Decision Making for Sustainability (W)
EAS 501.014/CEE 686/ChE 686 (3cr)	Environmental Finance (F)
EAS 501.018 (3cr)	Energy Justice (F)
EAS 535/LHC 536 (2.25)	Ethics Corporate Management (F or W)
EAS 512/STRAT 564 (1.5)	Strategies for Sustainable Development I (F)
EAS 513/STRAT 565 (1.5)	Strategies for Sustainable Development II (F)
EAS 527/BE 527 (3cr)	Energy Markets and Energy Politics (F)
EAS 532 (3cr)	Natural Resources and Environ Conflict Management (F)
EAS 533 (3cr)	Negotiation Skills (F)
BE 555 (1.5)	Non Market Strategy (F)
EAS 560/UP 560 (3cr)	Behavior and Environment (F)
ENGR 521 (3cr)	CleanTech Entrepreneurship (F)
FIN 637 (2.25cr)	Finance and Sustainable Enterprises (F)
FIN 583 (1.5cr)	Energy Project Finance (W)
STRAT 735-739 (1.5cr)	Topics in Global Sustainable Enterprise (F)

### B) Sustainable Systems Electives

B1) Additional SS courses (can count towards Non-Opus option)

EAS 572(2cr)	Environmental Impact Assessment (F)
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EAS 523(3cr)	Environmental Risk Assessment (W)
EHS 672 (3cr)	Life Cycle Assessment: Human Health & Environ Impacts (F)
EAS 552 (3cr)	Ecosystem Services
BA 612 (2.25cr)	Strategies for the Base of the Pyramid (F)
ESENG 501 (3cr)	Seminars in Energy Science, Technology, and Policy (F)
Econ 437 (3cr)	Energy Economics & Policy (W)
UP 533/ARCH 506 (3cr)	Sustainable Urbanism and Architecture (F)

### **B2) Sustainable Systems Themes (see links for course listings):**

Energy Systems - <http://www.seas.umich.edu/node/7746/#energy>

Mobility Systems - <http://www.seas.umich.edu/node/7746/#transportation>

Water Systems - <http://www.seas.umich.edu/node/7746/#water>

Food Systems - <http://www.seas.umich.edu/node/7746/#food>

Built Environment - <http://www.seas.umich.edu/node/7746/#builtenv>

Climate Change - <http://www.seas.umich.edu/node/7746/#climchange>

### **Cognates**

SEAS – Minimum 4 credits outside SEAS. Can be fulfilled with CEE coursework.

CEE – 6 credits of non-CEE coursework. Can be fulfilled with one advanced Mathematics course (proper choice of SEAS Analytical courses can also satisfy this requirement) and one SEAS course.

### **Integrated Analytic Methods and Skills Requirement**

Students are required, at some point during their time enrolled in the program, to take 2 courses composing at least 3 credits from a faculty-approved list of courses that focus on integrative analytic methods and skills. The faculty-approved existing courses that satisfy this requirement are listed below:

#### **Fall**

501 – Social Vulnerability & Adaptation to Environ Change

578 – Urban Stormwater

530 - Decision Making for Sustainability

552 – Ecosystem Services

572 – Environmental Impact Assessment

533 – Negotiation Skills

536 – Mediation Skills

547 – Forest Ecology

553 – Diverse Farming Systems

570 – Environmental Economics

597 – Environmental Systems Analysis

564 – Localization Seminar

677 – Climate Adaptation Seminar

687 – Landscape Planning

#### **Winter**

501 – Stakeholder Network Analysis

501 – Science and Management of the Great Lakes

532 – Natural Resource Conflict Management

545- Applied Ecosystem Modeling

549 – Analysis and Modeling of Ecological Data

550 – Systems Thinking for Sustainable Development

557 – Industrial Ecology

581 – Advanced Education for Environment and Sustainability

589 – Ecological Restoration

610 – Advanced LCA Methods and Software Tools

641 – Social Research Methods in Environment and Sustainability

787 – Metro Studio (MLA only)