University of Michigan
Engineering Sustainable Systems
Sustainable Water Systems specialization

Dual-Master's Degree Program
Summary of Requirements for a Master of Science **(Sustainable Systems)** and a Master of Science in Engineering **(Civil Engineering)**
Effective Fall 2016

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)			
Natural Resources and Environment	**SS CORE**	*6CR* in Systems Analysis for Sustainability		Required: NRE 557/CEE 586 And one course from List A1 (next page)	NRE 557		
		9CR total	Sustainable Design & Technology *Minimum 3CR*	Required: See List A2 for acceptable courses (next page)			
			Sustainable Enterprise *Minimum 3CR*	See List A3 for acceptable courses (next page)			
			Additional 3CR minimum from list A1, 2, or 3	See attached list (A1-3) of acceptable courses in these specializations			
	NRE Core	NRE 509 NRE 510					
		IAMS Requirement Two courses; 3CR minimum Please see page 3 for approved courses.					
	Analytics *]*	*3CR* in Analytics		NRE 538 or equivalent required:			
	Opus*	Students are **not** expected to complete an Opus, but could petition to do a thesis/practicum or project*		At most *6CR* of NRE 700/701			
	Cognates *[Rackham requirement]*			Please see next page for cognate requirement information			
	TOTALS	**MINIMUM CREDIT HOURS BY SCHOOL**		**"NRE" – 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

Last Updated 05/31/2016

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 (F&W)
CEE 582 (3)	Environmental Microbiology (F)
CEE 586/NRE 557 (3)	Industrial Ecology (W)
CEE 624 (3)	Restoration Fundamentals and Practice in Aquatic Systems (F)

Natural Resources and Environment

A) Sustainable Systems Core (1-3)

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

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

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

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

2) Sustainable Design & Technology (3CR)

NRE 537 (3cr)	Urban Sustainability (F)
NRE 501.087 (3CR)	Technology and Community Sustainable Development (W)
NRE 615 (3CR)	Renewable Electricity and the Grid (W)
NRE 574/PUBPOL 519 (3cr)	Sustainable Energy Systems (F)
NRE 548 (3cr)	Land Use and Global Change (F)
NRE 605/BA 605 (3cr)	Green Development (W)
NRE 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)

NRE 501.159 (3cr)	Decision Making for Sustainability(W)
NRE 501.014/CEE 686/ChE 686 (3cr)	Environmental Finance (F)
NRE 512/LHC 536 (2.25)	Ethics Corporate Management (F or W)
NRE 513/STRAT 564&564 (3cr)	Strategies for Sustainable Development (F)
NRE 527/BE 527 (3cr)	Energy Markets and Energy Politics (F)
NRE 532 (3cr)	Natural Resources and Environ Conflict Management (F)
NRE 533 (3cr)	Negotiation Skills (F)
BE 555 (1.5)	Non Market Strategy (F)
NRE 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)

NRE 514 (2cr)	Environmental Impact Assessment (F)
NRE 523(3cr)	Environmental Risk Assessment (W)
EHS 672 (3cr)	Life Cycle Assessment: Human Health & Environ Impacts (F)
NRE 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.snre.umich.edu/node/7746/#energy
Mobility Systems - http://www.snre.umich.edu/node/7746/#transportation
Water Systems - http://www.snre.umich.edu/node/7746/#water
Food Systems - http://www.snre.umich.edu/node/7746/#food
Built Environment - http://www.snre.umich.edu/node/7746/#builtenv
Climate Change - http://www.snre.umich.edu/node/7746/#climchange

Cognates

SNRE – Minimum 4 credits outside SNRE. Can be fulfilled with CEE coursework.
CEE – 6 credits of non-CEE coursework. Can be fulfilled with one advanced Mathematics course (proper choice of SNRE Analytical courses can also satisfy this requirement) and one SNRE 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
552 – Ecosystem Services
514 – Environmental Impact Assessment
533 – Negotiation Skills
536 – Mediation Skills
548 – Land Use and Global Change
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
501 - Decision Making for Sustainability
532 – Natural Resource Conflict Management
545- Applied Ecosystem Modeling
550 – Systems Thinking for Sustainable Development
557 – Industrial Ecology
581 – Advanced Environmental Education
589 – Ecological Restoration
610 – Advanced LCA Methods and Software Tools
641 – Interdisciplinary Research Methods
787 – Metro Studio (MLA only)