List B Environmental Engineering <u>Technical Electives (upper-division)</u>- at least <u>two</u> courses from this list (or a second from list A, no double counting). Faculty can petition to add additional courses:

Students are encouraged to select courses that meet their career goals and interests. This may include courses within a <u>similar theme or crosscut a breadth</u> of environmental engineering topics. As such, this list is organized under various specialization topics within environmental engineering. *Environmental engineering design courses from List A also fit under these various specialization topics*.

It can be critical that early in the curriculum that students pay careful attention to pre-requisites for these technical electives, as discussed in section 2.1.2. All courses that are numbered 5000 or above are graduate level courses and can only be taken with instructor permission; students should consult carefully with their advisor before selecting a graduate level course. Graduate level courses are good options for double-counting for students admitted to the BS/MS program.

<u>Air Quality</u>
ATOC 3500/CHEM 3151 Air Chemistry and Pollution (3 credits S, prereqs: two semesters chemistry)
ATOC 4720 Introduction to Atmospheric Physics and Dynamics (3 credits F, prereq: APPM 1350, PHYS 1110)
CVEN 4554 Fundamentals of Air Quality Management (3 credits F, prereqs: APPM 2360, fluid mechanics)
[1]MCEN 3032 Thermodynamics 2 (3 credits F&S, prereqs: thermodynamics and fluid mechanics)
MCEN 4141 Indoor Air Pollution (3 credits I*, prereqs: fluid mechanics, heat transfer)
MCEN 4057 Environmental Modeling (3 credits I*, prereqs: chemistry, fluid mechanics, COEN 1300)
MCEN 4032 Sustainable Energy (3 credits F, prereq: thermodynamics, heat)

<u>Applied Ecology</u>
CVEN 3434 Intro to Applied Ecology (3 credits S, prereqs: CHEN 1211-1221)
EBIO 4155 Ecosystem Ecology (3 credits S prereqs: CVEN 3434 or EBIO 1240, EBIO 2040 or EBIO 3020†)
EBIO 4020 Stream Biology (3 credits I*, prereqs: CVEN 3434 or EBIO 1240, EBIO 2040 †)
EBIO 4030 Limnology (3 credits S, prereqs: CVEN 3434 or EBIO 1240, EBIO 2040 †)
EBIO 4060 Landscape Ecology (3 credits F, prereq: CVEN 3434 or EBIO 1240)
EBIO/GEOL/ENVS 4160 Introduction to Biogeochemistry (3 credits S, prereq: CHEM 1011 or higher, EBIO 4155 or GEOL 3320)

<u>Energy Conversion Fundamentals</u>
AREN 3040 Circuits for Architectural Engineers (3 credits S, prereqs: APPM 2360, PHYS 1120, Restricted to AREN or CVEN students)
AREN 5020 Building Energy Audits (3 credits, I*, prereq: AREN 3010 or equivalent, instructor permission required)
AREN 5050 Advanced Solar Design (3 credits I*, prereq: AREN 2120 or equivalent, instructor permission required)
CVEN 5614 Bioenergy and Bioresources Recovery (3 credits I*, desired prereq: CVEN 4484, instructor permission required)
CVEN 5544 Solid Waste (3 credits, S). Restricted to EVEN BAM students only no BS only degrees
ECEN 3010 Circuits and Electronics (3 credits F&S, prereqs: APPM 2360, PHYS 1140)
[1]MCEN 3032 Thermodynamics 2 (3 credits F&S, prereqs: MCEN 3012, MCEN 3021 or equivalents)
MCEN 4032 Sustainable Energy (3 credits F, prereq: thermodynamics and heat)
MCEN 4135 Wind Energy and Wind Turbine Design (3 credits S, prereq: MCEN 3021 and ECEN 3010 [minimum grade C], Restricted to students with 87-180 credits)

CHEN 3660 Energy Fundamentals (3 credits S, prereqs: CHEN 1211 or CHEM 1133 or MCEN 1024 and PHYS 1110 and APPM 1360 or MATH 2300 [all minimum grade C-], Restricted to College of Engineering majors only)

Global Engineering
[1]CVEN 3424 Water and Wastewater Treatment (3 credits S, prereq: CVEN 3414)
CVEN 4554 Fundamentals of Air Quality Management (3 credits F, Prereq: APPM 2360 [or MATH 3130 and 4430] and CHEN 3313 [or CHEN 3200 or MCEN 3021])
CVEN 4834/5544 Solid Waste/Solid Waste Management & Resource Recovery (3 credits I*, recommended prereq: CVEN 3414)
CVEN 4837 Sp Top: Global Engineering (3 credits, S)
CVEN 4969 Water Air Sanitation Hygiene (3 credits starting in 2017, prereq: CVEN 3414)
EMEN 4200 Technology and Entrepreneurship for the Developing World (3 credits F or sum, Jrs or Srs only)
GEOG 3682 Geography of International Development (3 credits F, recommended prereq: GEOG 1982, 1992, 2002 or 2412)

Remediation
CVEN 4353 Groundwater Engineering (3 credits, F; prereq: CVEN 3313 or equivalent fluid mechanics course)
[1]CVEN 4474 Hazardous and Industrial Waste Management (3 credits I*, prereq: CVEN 3414)
CVEN 4834/5544 Solid Waste/Solid Waste Management & Resource Recovery (3 credits I*, recommended prereq: CVEN 3414)
EVEN 4100 Environmental Sampling and Analysis (3 credits, F, prereqs: CVEN 4404/4414, fluid mechanics or instructor consent)
GEOL 3030 Introduction to Hydrogeology (3 credits, F, prereqs: GEOL 1010 or GEOL 2100 and MATH 1300, or instructor consent)
GEOL 4716 Environmental Field Geochemistry (2 credits, F/I*, prereqs: GEOL 2700 or 2001, and CHEM 1011/1031, or CHEM 1113/1133, and GEOL 3320, or instructor consent, will need to make up extra 1 credit)
MCEN 4057 Environmental Modeling (3 credits, I*, prereqs: chemistry, fluid mechanics, CHEN 1310)

Water Resources and Treatment
[1]CVEN 3323 Hydraulic Engineering (3 credits, F; prereq: CVEN 3313 or CHEN 3200 or CVEN 3313 or GEEN 3853 or MCEN 3021 or AREN 2120)
[1]CVEN 3424 Water and Wastewater Treatment (3 credits, S, prereq: CVEN 3414)
[1]CVEN 4323 Water Resource Engineering Design (F, juniors/seniors)
CVEN 4353 Groundwater Engineering (3 credits, F, recommended prereq: CVEN 3313 or CHEN 3200 or CVEN 3313 or GEEN 3853 or MCEN 3021)
CVEN 4383 Groundwater Modeling (3 credits, S, prereq: CVEN 4353)
CVEN 4594 Water Reuse and Reclamation (3 credits, I*, prereq: CVEN 3414)
CVEN 5834 Sp Top: Small System Water/Wastewater Treatment (3 credits, I*)
EVEN 4830 Environmental Engineering Process Modeling (3 credits, F, prereqs: heat transfer and thermo)
GEOG 4501 Water Resources and Water Management of the Western U.S. (3 credits, S)
MCEN 4057 Environmental Modeling (3 credits, I*, prereqs: chemistry, fluid mechanics, COEN 1300)

[1] Also on List A
*I Offered intermittently