

## Suggested Courses for ME Students Interested in Green Engineering

Please see <http://www.eng.vt.edu/green/> for information on the Green Engineering minor.

### Technical Electives:

*A limit of 6 credits of List #2 technical electives can be used to satisfy the 15 credits of technical electives required to earn a BSME degree. There is no limit in List #1 technical electives. Be sure to consult the current list of approved technical electives for the year in which you plan to graduate to make sure the courses listed below are valid technical electives.*

### List #1 Technical Electives:

#### **ENGR 3124 – Introduction to Green Engineering (3 credits)**

**\*\*Required for Green Engineering minor\*\***

Introduction to green engineering and global environmental issues. Impacts of human and engineering activities on the environment, and techniques that can be utilized to minimize adverse environmental impacts with emphasis on ISO 14000, and environmentally conscious design and manufacturing. Pre: (CHEM 1035 or CHEM 1074), (ENGE 1104 or ENGE 1114), PHYS 2306. This course may be restricted to Green minors only.

#### **ENGR 4134 – Environmental Life Cycle Analysis & Materials Selection (3 credits). Spring only.**

**\*\*Required for Green Engineering minor\*\***

Quantification of the environmental impacts for products, processes, and systems across all engineering disciplines. A detailed look at life cycle phases and formal and informal Life Cycle Assessment (LCA) methodologies including ISO standards, stream-lined LCA, green building ratings systems, carbon footprints, and other environmental ratings systems. Pre: ENGR 3124.

#### **ME/ESM 4194 - Sustainable Energy Solutions (3 credits).**

Addresses energy metrics, global and US energy supply and demand, transitional energy sources (natural gas, petroleum, coal, nuclear), sustainable/renewable source (solar, geothermal, hydro, tidal, wind, biofuels), and methods for increasing efficiencies (energy storage, batteries, green building, conservation). Options for transportation, electricity, lighting and heating needs of industry, agriculture, community, and citizens. Production, transmission, storage, and disposal issues considered in the context of global political, economic, and environmental impacts. Senior Standing in major may be substituted for pre-requisite ENGL 3764. Pre: (Chem 1035 or 1055), PHYS 2306, and ENGL 3764.

#### **CEE 3104 – Introduction to Environmental Engineering (3 credits) - also an Area 7 CLE Elective**

Overall view of environmental engineering with emphasis on hazardous waste management, water treatment, wastewater treatment, air pollution and its control, solid waste management, groundwater pollution and environmental regulations. Pre: C- or better in (CHEM 1035 or 1074), (CHEM1045 or 1084), (MATH 1206 or 1226 or 2203), 1206, and PHYS 2305. This course may be restricted by major, see timetable for details.

#### **ME 4154 – Industrial Energy Management (3 credits)**

Comprehensive study of managing energy resources and usage in an industrial plant. Four areas of energy management are covered: how to organize an energy management program in an industrial plant; techniques for conducting industrial energy surveys; how to make energy systems more efficient; and the design and analysis of energy systems. Pre: ME3114 or ME3124.

#### **ME4164 – Energy Systems for Buildings (3 credits) Spring only.**

Application of the fundamental principles of thermodynamics, heat transfer, and fluid flow to analyze energy use for building environmental control. Exploration of approaches for configuring basic thermal-fluid engineering components (e.g. pumps, piping, fans, heat exchangers, refrigeration cycles, etc.) to yield

systems that provide heating, cooling, and ventilation. Introduction to techniques and software tools for estimating energy use by these systems and the associated economic and environment impact. Examination of alternate technologies for meeting building energy needs including small scale combined heat and power systems and renewable energy systems. Pre: ME 2124, ME 3124.

**ME4204 – Internal Combustion Engines (3 credits) Spring only.**

Analysis and design of gasoline and diesel engines. Fundamental processes and their application in current technology. Thermodynamics: air standard and air-fuel cycles. Combustion: stoichiometry, fuels, chemical equilibrium, chemical kinetics, flame propagation, knock, pollutant formation and control. Flow processes: volumetric efficiency, intake and exhaust tuning, two-stroke scavenging, carburetion, fuel injection, super- and turbo-charging. Pre: 3124, 3404. Cannot be taken P/F.

**ME 4554 – Advanced Technology Motor Vehicles (3 credits) Fall only.**

Energy use and environmental issues for motor vehicles: Emissions standards, fleet requirements, dynamometer testing, fuel economy, and vehicle performance. Alternative fuel vehicles: Characteristics and infrastructure of fuels, batteries, electric vehicles, and hybrid electric vehicles. Vehicle design: Modeling and simulation of vehicle energy use and performance, component sizing. Fuel cells for transportation. Heavy-duty vehicles and busses. Low mass vehicles and future vehicle technology. Pre: ME3114 or ME3124 or ME3134. Cannot be taken P/F. Graduating Seniors only.

**ME 4034 – Bio-Inspired Technology (3 credits) Spring only.**

Introduction to engineering solutions inspired by biological systems. Overview over the approach of bio-inspired technology and the state of the art. Exploration of the relationship between engineered and natural biological systems. Explanation of concepts of biological systems, such as evolutionary optimization, sensing, actuation, control, system integration, assembly and materials in engineering terms. Practice of interdisciplinary analysis skills in technical report writing projects where man-made and biological systems are evaluated for parallels to engineering and their technological potential. Pre: (PHYS 2205, PHYS 2206) or (PHYS 2305, PHYS 2306).

**NSEG 3145-3146 (3 credits each). Spring only.**

Application of fundamental principles of neutron physics and reactor theory. Introduction to nuclear cross-section data, neutron scattering, nuclear fission, and diffusion theory. Examination of current and next generation nuclear power. Pre: for 3145: MATH 2214 or MATH 2215H, Fall only; for 3146: 3145 or ME 3145.

**UAP4394 – Community Renewable Energy Systems (3 credits) Spring only.**

**\*\*also an Interdisciplinary Green Elective for minor\*\***

Practical design fundamentals for small scale renewable energy systems: solar building heating and cooling; solar domestic hot water; wind, photovoltaic, and hydroelectric systems; alcohol, methane and other biomass conversion systems. Developing plans, programs, and policies to stimulate development of renewable systems. Pre: (MATH 1016 or MATH 1025).

**GEOS 3104 – Elementary Geophysics (3 credits) Spring only.**

**\*\*also an Interdisciplinary Green Elective for minor\*\***

Acquisition and interpretation of exploration geophysical data. Seismic reflection and refraction methods, gravity and magnetic fields, geoelectrical methods, and geophysical well logging. Pre: (MATH 1205 or 1225), (MATH 1206 or 1226), (GEOS 1004 or 2104), and PHYS 2305. Co-req: PHYS 2306. **This course has a \$95 fee.**

**GEOS 3114 – Introduction to Meteorology (3 credits)**

**\*\*also an Interdisciplinary Green Elective for minor\*\***

A nonmathematical introduction to meteorology including consideration of the structure of the atmosphere, energy balance in the atmosphere, clouds and precipitation, air masses and fronts, global

circulation, storms, climatology, catastrophic weather, meteorological optics, and forecasting.

**Curriculum for Liberal Education Electives:**

If considering a Green Engineering Minor, these courses will double count for CLE credit as listed below:

**FOR 2554 – Nature and American Values (3 credits)**

**Area 2 & Interdisciplinary Green Elective for minor**

Introduces students to the evolving relationship between nature and American society; emphasizing the ethics and values which underlie forest, park, and wildlife management. Students are introduced to contemporary land use issues and learn to articulate, defend, and critique the ethical positions surrounding these issues (i.e., wilderness, sustainability, biodiversity, hunting, old growth, suburban sprawl, environmental activism).

**PHIL 2304 – Global Ethics (3 credits)**

**Areas 2 & 7 & Interdisciplinary Green Elective for minor**

Ethical issues in international context. Application of the principles of moral theory to such issues as the obligations of richer nations toward poorer ones, cultural and other forms of relativism, emigration and immigration, nationalism, war, deterrence, intervention, environmental degradation, preservation of natural diversity, and responsibilities toward future generations.

**CEE 3104 – Introduction to Environmental Engineering (3 credits)**

**Area 7 & List #1 Technical Elective & Green Engineering Elective for minor**

Overall view of environmental engineering with emphasis on hazardous waste management, water treatment, wastewater treatment, air pollution and its control, solid waste management, groundwater pollution and environmental regulations. Pre C- or better in: CHEM 1035, 1045, MATH 1206 or 1226, MATH 2024 and PHYS 2305. This course may be restricted by major, see timetable for details.

**AAEC 3314 – Environmental Law (3 credits)**

**Area 7 & Interdisciplinary Green Elective for minor**

Principles of law involved in environmental issues, survey of environmental litigation, legislation and administrative rulings. Law topics include natural resources, water pollution, private land use, air pollution, toxic substance, food, drug, pesticides, and biotechnology. Spring only.

**ENGR 1814 – Energy, Resources, & the Environment (3 credits) – Area 7 only**

Population trends. Renewable and non-renewable energy. Coal mining methods, reclamation of mined lands. Petroleum and natural gas. Nuclear waste. Land management, aquifer depletion. Development of mineral reserves, surface and underground mining, environmental impacts. Minerals in world economics. Geopolitical concerns. Global environmental effects of industrial enterprises. Sustainable development. Effects of social structures. Regulatory processes and national/international legislation. Fall only.

**GEOS 1024 – Resources Geology (3 credits) – Area 7 only**

The nature, origin, occurrence, distribution, use, and limitations of the earth's mineral resources including abundant and scarce metals, precious metals and gems, building materials, industrial minerals, fossil fuels, nuclear energy, water, soils, and other minerals.

*\*courses in grey have not be offered for at least one academic year and may not be available*