July 22, 2021

MEES Course Catalog

MEES432/632 Physiological Ecology of Animals 3 credits Elective

Instructor: C. Rowe (CBL)

Frequency Offered: Odd springs

Environmental changes that are expressed at the population level are ultimately rooted in the responses of their constituent individuals to those changes. In this class we will use a thermodynamic/bioenergetic framework to examine some key physiological processes in animals. The course follows a path from underlying physical and biological theory, through discussion of specific physiological functions and their expression under different conditions, to viewing integrated physiological functions in the context of the individual's energy budget. Using physiology and energetics to understand larger, ecological patterns is a recurring theme. Prerequisite: An undergraduate class in Ecology. Offered as a 400-level and 600-level option.

MEES484/684 Marine Microbial Ecology 3 credits Elective

Instructor: F. Chen (IMET) and J. Cram (HPL)

Frequency Offered: Even springs

This course will familiarize students with the diversity, ecology, and biogeochemical roles of Bacteria, Archaea, microbial Eukaryotes, viruses, and fungi in the marine environment. The course will also cover the latest discoveries in molecular microbial ecology. Each main topic will begin with a lecture and will be followed by a paper discussion. For the paper discussions, each student will present selected papers specified in the syllabus (or by consensus with the course instructors). Students will also participate in class discussions.

MEES498I/698I Chesapeake Bay Health 3 credits Elective

Instructor: C. Mitchelmore (CBL)

Frequency Offered: Every fall

This course is designed to provide students with a broad perspective on the subject of environmental health issues pertinent to the Chesapeake Bay. It will be a comprehensive course in which a definitive description of basic concepts and principles, laboratory testing and field situations, and examples of typical data and their interpretation and use by industry and water resource managers, will be discussed. Numerous examples and case studies will be presented, many by local leading experts. In addition, concepts and examples will be discussed in a broader perspective with references to other estuarine systems (e.g. San Francisco Bay, Puget Sound). Classes will consist of lectures by the instructor together with some guest speakers in addition to group discussions. Offered as a 400-level or 600-level option.

MEES498Q/608Q Global Climate Change 3 credits Elective

Instructor: M. Cochrane (AL), L. Cooper (CBL), J. Grebmeir (CBL), H. Kilbourne (CBL), L. Lapham (CBL)

Frequency Offered: Odd springs

This course is designed to provide the student with a basic understanding of the underlying physics behind global and regional climate. Students will also gain knowledge of proxy data approaches and

resources that can be used for assessing past climates, integrated and up to date knowledge of the scientific basis for understanding major drivers and components of the Earth's climate system, Information on how natural events/phenomena and anthropogenic activities can influence regional and global climate, and a synthetic view of climate change predictions for the coming century.

MEES498T/698T Marine and Environmental Biotechnology 3 credits Elective

Instructor: J.S. Chung (IMET), et. al.

Frequency Offered: Every spring

This course covers the utility of molecular techniques to address questions in marine and environmental sciences, toxicology and sustainability, as well as their use in discovering and developing useful products from marine systems. Students will examine current molecular approaches to the study of biodiversity, bioremediation, food chains, discovery of drugs and enzymes from marine microbes and macroorganisms, sustainable aquaculture, development of biofuels, the role of marine microbes in global carbon cycling, and genomics of marine organisms.

MEES607 Quantitative Methods in Environmental Sciences 3 credits PD or Elective

Instructor: L. Sanford (HPL), H. Bi (CBL)

Frequency Offered: Even falls

This course reinforces and extends the mathematics skills that students bring to graduate studies in the environmental sciences. It explores mathematical approaches and solutions (both analytical and numerical) that cut across environmental disciplines, and it introduces data analysis techniques that are taught infrequently in other courses. The goal is to provide students with the tools and confidence they need to apply quantitative methods in their own research. The mathematical programming language MATLAB is used to solve problems in class, to complete homework sets, and to process and analyze online data. MEES 607 assumes a background in at least Calculus I (differential calculus); Calculus II (integral calculus) is not required, though it is preferable.

MEES609C Skills for Team Science 1 credits PD or Elective

Instructor: K. Rose (HPL)

Frequency Offered: Odd Springs

This professional development course focuses on providing students with the inter-personal skills for ensuring that projects and other activities that rely on a team science approach are effective, successful, and rewarding. Team science is rapidly becoming the norm for how research and problem solving is done in science. Students entering the academic, government, non-governmental organization, and private sector will frequently be involved with various types of group efforts. The "Science of Team Science" is rapidly emerging field and this course will use recently developed ideas in lectures and readings that include philosophy and case studies about environmental and marine sciences. The material will provide the students with both a broad conceptual understanding of the benefits and challenges of team science and practical ways to encourage and ensure that the team science efforts are effective.

MEES608B Responsible Conduct of Research 1 credit PD or Elective

Instructor: T. Miller (CBL) and R. Hill (IMET)

Frequency Offered: Every fall
In this seminar we explore the "rules of the road" for being a scientist today. Using a case study approach, the seminar will cover concepts of how science is regulated, what constitutes misconduct, how research is planned, conducted and reported, authorship and data ownership, as well as the ethical treatment of human and animal subjects. The seminar will focus particularly on mentor -trainee interactions and on issues pertaining to diversity in the sciences are also discussed.

MEES608D Scientific Writing and Communication 2 credits PD or Elective
Instructor: E. North (HPL), C. Palinkas (HPL), J. Cram (HPL), and W. Nardin (HPL)
Frequency Offered: Every fall
Prerequisite: permission of instructor - participants should have data that they can use in a draft scientific paper, or they should be ready to write a draft of their research proposal.
This course provides an introduction to writing scientific papers and conference abstracts, giving scientific talks and posters, and preparing resumes and seeking jobs. There will be exercises in writing and editing which can be focused on data collected as part of a participant's graduate research. Students will become critically aware of factors that lead to excellence in communicating about science.

MEES608F Current Topics in Fisheries 1 credit Seminar/Elective
Instructor: B. Stevens (UMES)
Frequency Offered: Every spring
This class will explore topics of current interest in the fisheries sciences. Different topics are chosen each year. The class consists of a mix of readings and presentations
by professional fishery scientists concerning different aspects of fisheries and their management. Emphasis will be placed on case studies of specific fisheries, and current management problems (e.g., overfishing, bycatch, discards, ghost fishing, etc). Students will explore current and classic literature on the selected topics, and complete a final project that could be a presentation or group project (e.g. mock fishery council).

MEES608O Topics in Omics 1 credit Seminar/Elective
Instructor: J.S. Chung (IMET) and J. Du (IMET)
Frequency Offered: Every fall
In each semester, the class discusses different topics and a few classical papers published in cell and molecular biology, developmental genetics, neuroscience, and reproductive biology. Articles published in genetics, endocrinology, and biochemistry will be also covered. The goal is to provide students a better understanding of the most current molecular tools and techniques used in research areas such as cell and molecular biology, development genetics, neuroscience, and reproductive biology.

MEES608R Applied Bayesian Statistics 1 credit PD or Elective
Instructor: D. Liang (CBL)
Frequency Offered: Even falls
This course will introduce mixed-effects modelling from a Bayesian perspective. Mixed modeling is a unifying framework for analyzing continuous, count, presence / absence and zero inflated data from

environmental applications. We will explore the selection, interpretation and reporting of Bayesian mixed modelling results. The statistical programming language R and packages R-INLA, STAN will be used in the labs and projects. Previous coursework in applied statistics (MEES:698B) and R statistical programming (MEES:708N), or their equivalences are recommended for this course.

MEES608S Current Topics in Oceanography: Estuarine and Coastal Ocean Modeling
1-2 credits Seminar/Elective
Instructor: M. Xia (UMES)
Frequency Offered: Every fall

MEES609A Applied Environmental Science 2 credits PD or Elective
Instructor: T. Miller (CBL) and C. Mitchelmore (CBL)
Frequency Offered: Every spring
This course has been designed to promote an appreciation of interdisciplinarity in natural and social sciences addressing environmental challenges affecting society today. The course addresses the role of science and scientists in providing information to policy makers and managers on complex environmental challenges. In so doing, we make a distinction between science informing policy and advocating for change. The course will provide experience in critical evaluation and synthesis of scientific literature. We will cover case studies of how science relevant to several environmental problems has been synthesized to inform policy. We will provide training in how to work in interdisciplinary teams, using a range of synthesis and analytical approaches. This will culminate in the development and oral presentation of group reports that analyze and evaluate current complex environmental challenges that require an interdisciplinary approach to achieve progress.

MEES609B Scientific Job Skills 101 1 credit PD or Elective
Instructor: D. Nelson (AL) and H. Kilbourne (CBL)
Frequency Offered: Even springs
Upon leaving graduate school and entering the “real world” many former students realize that they received excellent training in some areas of being a scientist (e.g. conducting research, analyzing data, writing manuscripts and proposals, giving talks at conferences, and even communicating with broader audiences), but not in others (e.g. interpersonal skills, managing a project). This course will address some of these what-they-never-taught-me-in-graduate-school-about-being-a-scientist issues, such as hiring and managing people, creating a culture that supports the research, and communication. Kathy Barker’s 2010 book entitled “At the Helm: Leading Your Laboratory” will be used to guide in-class discussions. This class will also provide an overview of other often-overlooked topics, such as creating proposal budgets and managing a project. Additional class sessions will be allotted for other related topics that students wish to discuss. Outside scientists working in a diversity of sectors will be invited to participate in class sessions to provide perspective on skills that are critical in their jobs on a day-to-day basis. The goal is to provide students with training in often overlooked skills that are nevertheless critical to everyday life as a scientist, whether in academia, government, or private sectors.

MEES611 Estuarine Systems Ecology 3 credits Elective
Instructor: J. Testa (CBL)

Frequency Offered: Odd springs

This course provides an integrated view of estuarine ecosystem processes and the numerical modeling methods used to analyze and predict these processes. The course is organized into three parts presented in parallel: 1) introduction to estuarine ecology; 2) introduction to numerical modeling; 3) student modeling projects. Lectures seek to address aspects of benthic and plankton ecology, light and primary production, and estuarine biogeochemistry, with the aim of applying this knowledge to understand systems-level concepts of ecosystem metabolism, food webs, feedbacks, and the interactions within coupled human-natural ecosystems. Lectures are supported by in-class activities and homework assignments that introduce numerical modeling methods and their application to many types of ecosystems. The course culminates in a student project that includes co-development of a numerical model and its application to answer a question of the student's choice.

MEES614 Spatial Ecology in R 4 credits Elective

Instructor: M. Fitzpatrick (AL) and H. Bailey (CBL)

Frequency Offered: Even falls

Many ecological questions in terrestrial and marine systems originate from the observation that organisms and the ecological processes that influence them vary in space. This course emphasizes the study of spatial ecological patterns (including animal movement), the processes that generate and maintain these patterns and processes, and the construction of models in R to analyze, simulate, and understand the interplay between spatial pattern, ecological processes, and scale. The objective of the course is to introduce students to ecological theories and concepts relevant to the study of spatial ecological patterns in terrestrial and marine systems, while providing the R skills necessary to articulate and answer scientific questions by confronting models with data

MEES617 Hydrological Effects of Land Use Change 3 credits Elective

Instructor: K. Eshleman (AL), J. Testa (CBL), et.al.

Frequency Offered: Even springs

Examines the catchment-scale hydrological effects attributable to major land use and land cover alterations, including both anthropic and non-anthropic disturbances. First part of the course will focus on the quantitative measurement and mathematical description of those physical hydrological processes that can be affected by land use and land cover changes. Second part of the course will review how both deterministic and empirical/statistical models can be applied to analyze and predict observed catchment-scale hydrological and water quality responses to land alterations and disturbances, including delivery of nutrients and suspended materials from the land surface to receiving waters and estuarine systems.

MEES618C Next Generation Sequence and Analysis 2 credits Elective

Instructor: T. Bachvaroff (IMET)

Frequency Offered: Every spring

This course is designed to expose the student to a broad range of sequence analysis tools with lectures, computer lab, and project based components. The primary learning outcome is to develop independence in troubleshooting sequence analysis with the large-scale sequence datasets that have

become common. In addition, an overview of the major types of analysis and assembly processes will be given, with adjustments to emphasize specific student projects.

MEES618D Ethical Aspects of Environmental Science 1 credit PD or Seminar
Instructor: C. Palinkas (HPL)
Frequency Offered: Even springs
Humans and their environment are inherently linked, especially in coastal and estuarine regions, and scientific and social values often must be balanced in ecosystem management and decision-making. This seminar examines these issues through the lens of GeoEthics, the ethical, social and cultural implications of geoscience research and practice, using a case-study approach. Example topics could include practices such as fracking, offshore wind farming, and dam removal, as well as behaviors and attitudes of scientists conducting research.

MEES620 Environment and Society 3 credits Foundation
Instructor: Faculty
Frequency Offered: Every fall
In this course, we will consider various ways of understanding how aspects of the environment, society and culture society interact with one another. We will begin by considering literature that conceptualizes such interactions in the framework of a coupled 'system'. From there, we will explore literature from related fields to deepen our understandings of how humans, society, and culture interact with and impact their environment (and the other way around).The course will be very interactive, and require regular participation and attendance. Throughout the semester, students will be encouraged to think about their own 'system' composed of human and natural elements, and to think about the dynamics of this system from the viewpoints of various bodies of environmental and social science literature. Students will develop skills in oral and written communication, as well as experience in conducting individual research into their chosen topic.

MEES621 Biological Oceanography 4 credits Elective
Instructor: R. Hood (HPL), J. O'Neil (HPL), and L. Plough (HPL)
Frequency Offered: Every spring
MEES 621 is a 4-credit core course in the MEES program that provides an overview of Biological Oceanography for incoming graduate students. The course emphasizes fundamental concepts which include marine biogeochemistry and ecology and biological-physical interactions in both pelagic and benthic environments from the tropics to the polar seas and from the surface ocean to the deep sea, including estuaries. The course includes four hours of lecture per week augmented by one field trip to Poplar Island and two cruises on the Choptank River focusing on physical/plankton/water column processes and fisheries oceanography/benthic ecology. MEES graduate students are encouraged to consider this course for the second semester of graduate school in the MEES program. MEES 621 is available system wide via synchronous online video.

MEES622 Sustainability Science: Quantitative System Approach 3 credits Elective
Instructor: X. Zhang (AL) and E. Davidson (AL)
Frequency Offered: Even springs

Although sustainability encompasses topics beyond the natural sciences, the environmental sciences can offer tools to help define and assess sustainability. Indeed, forestry and fisheries management have a long history of developing sustainable yield concepts, with varying historical success in implementation. Modern sustainability science goes beyond single- resource management and integrates biophysical and socio-economic considerations of sustainability. This course is designed to help provide students with a historical background, critical thinking approaches, and analytical tools to address sustainability from a scientific perspective by: 1) reviewing and discussing basic concepts, past and active debates, and cutting-edge ideas; 2) learning and applying system and quantitative analysis skills; 3) developing a case study for a country/topic of interest in a highly-diversified group.

MEES627 Environmental Biogeochemistry 3 credits Elective

Instructor: S. Malkin (HPL) and H. Kilbourne (CBL)

Frequency Offered: Odd springs

This course is a detailed examination of Earth's biogeochemical cycles, with an emphasis on major elements and carbon cycling through globally important biomes. The course employs a textbook, which is supplemented with weekly readings that include foundational review papers, and original scientific works. Topics include biogeochemical cycles of organic carbon and nutrients in terrestrial, lacustrine, wetland, and marine systems. Emphasis is placed on understanding how global rates of geochemical transformations are estimated and how these rates may be changing during the Anthropocene.
We will have lectures introducing each topic and then you will have the opportunity to use the information in the lecture to deepen your understanding by discussing peer review literature on the same topic. Students will acquire skills in quantitative approaches to environmental geochemistry through classroom instruction and regular analytical problem sets.

MEES631 Fish Ecology 3 credits Elective

Instructor: D. Secor (CBL) and T. Miller (CBL)

Frequency Offered: Even springs

Understanding basic ecological processes that affect productivity, abundances and distributions is a prerequisite for effective utilization of Maryland's aquatic resources. This course will explore the forces that select individuals, regulate populations and structure communities.

MEES637 Plankton Ecology 3 credits Elective

Instructor: J. Pierson (HPL)

Frequency Offered: Odd falls

The goal of this course is to provide students with a quantitative understanding of phytoplankton and zooplankton ecology, including growth and grazing, population dynamics, nutrition, behavior, trophic interactions, and bio-physical interactions, to answer the overarching question: *What controls the magnitude, distribution, and transfer of production in plankton communities in estuaries, coastal, and open ocean systems?* Emphasis will be placed on critical analysis of plankton dynamics from a variety of public data sources, in-class discussions of peer-reviewed papers, and assessment of simple numerical models of plankton dynamics. Grading will be based on a combination of homework problem sets, a written proposal, and class participation in discussions.

MEES640 Interconnected Earth Systems: Land, Ocean, and Estuary 3 credits Foundation

Instructor: Faculty

Frequency Offered: Every fall
Students will gain a fundamental understanding of the physical and biogeochemical dynamics of the earth-estuarine-ocean system including general transport processes governing movement of materials and energy across environments**.** Students will explore connections linking physical and biogeochemical processes in the atmosphere, land, estuaries and the ocean as well as understanding the concept of conservation of energy across systems, and linking theoretical knowledge with real world examples. Students will gain process-based knowledge of the earth-estuarine-ocean system from theoretical, experimental, and empirical vantage points.

MEES650 Wetland Ecology 3 credits Elective
Instructor: A. Baldwin
Frequency Offered: Every fall
Plant and animal communities, biogeochemistry, and ecosystem properties of wetland systems. In-class laboratory will emphasize collection and analysis of field data on wetland vegetation, soil, and hydrology. Course requires two Saturday field trips. Cross-listed as ENST450 and ENST650, credit awarded for only one.

MEES660 Ecological Systems 3 credits Foundation
Instructor: Faculty
Frequency Offered: Every fall
A broad understanding of ecological concepts is required of all students who will take ecology courses within the MEES (Marine, Estuarine and Environmental Science) program. This course provides an introduction to the field of ecology for matriculating graduate students and prepares them for more advanced concepts. We emphasize a "*hands on*" approach to learning ecology, both inside and outside of the classroom. Students will be exposed to ecology both in theory and practice, through lectures, readings, and discussions with practitioners using foundational and advanced concepts in their jobs. In addition, students will complete quantitative exercises and lead a series of debates focused on classical and topical issues/questions in ecology. The concept of global change will be a constant, unifying thread throughout this course. As the footprint of human activities on ecological systems continues to expand during the anthropocene, it has become critical for today's burgeoning scientists to understand the role of humans as drivers of ecological change at multiple scales. This course will provide students with the background to pursue advanced graduate level courses in their specialized areas of interest.

MEES661 Physics of Estuarine and Marine Environments 3 credits Elective
Instructor: V. Coles (HPL) and M. Li (HPL)
Frequency Offered: Odd springs
Graduate-level introduction to physical oceanography, covering a wide range of physical processes in oceans and estuaries. Topics include ocean currents, water mass properties, heat and salt balances, dynamical oceanography, waves, tides, turbulence, sediment transport, estuarine circulation, and continental shelf circulation.

MEES663 Ecological Genomics 3 credits Elective
Instructor: L. Plough (HPL) and C. Fuchsman (HPL)

Frequency Offered: Even falls

New technologies in genomics, especially next-generation sequencing, have revolutionized the fields of ecology and evolutionary biology across all hierarchical levels of biological organization. Within virtually any species, we can now study genetic diversity and gene expression across the entire genome to understand adaptation to current environments and responses to global change. In multi-species contexts, we now have the tools to understand the importance of interspecific gene flow in adaptation, determine the role of genetic diversity in community composition, and characterize the diversity and function of cryptic organisms, such as microbes, in communities and ecosystems. This course will cover the major research topics in ecological genomics, considering individual, population, interspecific, and community and ecosystem hierarchical levels. The course will comprise lectures, student-led discussions of primary literature exemplifying applications of genomics to contemporary environmental problems, and hands-on experience manipulating and analyzing real genomic data sets with the latest bioinformatic tools in the UNIX/Linux and R environments.

MEES680 Cell & Molecular Biology for Environmental Scientists 3 Credits Foundation

Instructor: A. Place (IMET) and Y. Li (IMET)

Frequency Offered: Every fall

The goal of this course is to introduce environmental scientists to the methods and approaches that are the foundations for today's breakthroughs in molecular and cellular biology. Detailed examination of papers published in the last few years along with online background material will be used to reinforce the connection of key concepts to experimentation.

MEES681 Advanced Ecological Design 3 credits Elective

Instructor: S. Lansing (UMCP)

Frequency Offered: Odd springs

An advanced survey course on the field of ecological design including illustration of principles of design with case studies from biologically-based waste treatment systems, ecosystem management and sustainable development. Cross-listed as ENST 481 and ENST 681, credit awarded for only one.

MEES682 Fisheries Science and Management 3 credits Elective

Instructor: G. Nesslage (CBL) and M. Wilberg (CBL)

Frequency Offered: Even falls

This course will introduce students to central concepts underlying fisheries science and management, including fishery and stock dynamics, surplus production and yield-based management, age-structured assessments, biological reference points, spatial and ecosystem-based fisheries management, effects of overfishing on socioecological systems, management methods and challenges, and institutional structures.

MEES688 Surface Water Quality Modeling 3 credits Elective

Instructor: M. Xia (UMES)

Frequency Offered: Even springs

This course is an introduction to the theory and application of mass balance-based mathematical models used to simulate the distribution of contaminants in the surface water as a contaminant migrates through the environment.

MEES698B Environmental Statistics I 3 credits PD or Elective

Instructor: D. Liang (CBL - odd falls) and V. Lyubchich (CBL - even falls)

Frequency Offered: Every fall

This course will extend quantitative training for students in the environmental sciences. It will explore the basic practices of statistics to inter-disciplinary environmental data. The goal is to train students with the statistical knowledge and tools needed to conduct statistical analysis in their own research. The statistical programming language R is used in class, to complete homework sets, and to analyze online data.

MEES698G Sediment Dynamics in Coastal and Estuarine Environments 3 credits Elective

Instructor: C. Palinkas (HPL) and W. Nardin (HPL)

Frequency Offered: Odd springs

This course is a graduate-level introduction to sediment dynamics occurring along the land-sea continuum, focusing on the portion spanning intertidal to nearshore regions. It will be divided into two parts: sediment transport processes and sedimentary environments (fluvial, intertidal, estuarine, coastal and nearshore regions). Human impacts on sedimentary processes, as well as responses to climate change, will also be considered. Sediment/biological interactions will be a theme throughout the course, including student-led discussions of recent publications.

MEES698M Modeling Chemical Equilibrium in Natural Waters 3 credits Elective

Instructor: J. Schijf (CBL)

Frequency Offered: Every fall

This course is designed to teach a broad range of environmental science students the foundations of chemical thermodynamics and kinetics as it applies to the composition of natural waters. The contents are focused on four processes that are major regulating forces in geochemical cycles: (i) pH control by the carbonate system; (ii) metal complexation and hydrolysis; (iii) redox chemistry; and (iv) precipitation/dissolution and solubility. The main objective of the course is the development of modeling skills, using standard codes like MINEQL, FITEQL, and CO2SYS. These will be practiced by means of in-class exercises and weekly problem sets. Final grades will be based on these homework assignments, as well as on the midterm and final exams. While there are no formal prerequisites to register, a basic understanding of equilibrium reactions and some familiarity with calculus and numerical analysis is assumed.

MEES698R Stable Isotopes in Environmental Research 3 credits Elective

Instructor: D. Nelson (AL), L. Cooper (CBL), L. Lapham (CBL), and H. Kilbourne (CBL)

Frequency Offered: Odd falls

Stable isotopes have become a fundamental analytical tool in atmospheric, terrestrial, freshwater and marine ecological sciences, extending earlier applications in geology and geochemistry in environmental sciences. This analytical technology has proven particularly useful in assessing responses to natural and human-induced environmental changes, as biomarkers, providing integrated measures of plant physiological ecology, and stable isotopes are also widely used as tracers of biological and biophysical processes. This course introduces the theory, nomenclature, methods and applications of stable

isotopes in environmental research. The course focuses on the stable isotopes of hydrogen, carbon, nitrogen, oxygen, and sulfur, and how they integrate and record important earth system and ecological processes. This course is designed for early-career graduate students who potentially have an interest in using these methodologies as part of research on biogeochemical processes and transformations.

MEES698X Global Environmental Remote Sensing 3 credits Elective
Instructor: A. Elmore (AL) and G. Silsbe (HPL)
Frequency Offered: Odd falls
Students will develop the knowledge and skillset necessary to employ remote sensing techniques to better understand ecosystem patterns and processes in terrestrial and aquatic environments. A combination of lectures, assignments, and fieldwork will expose students to the interface of remote sensing, ecosystem analysis, global change, and environmental management.

MEES699 Special Problems in Marine-Estuarine-Environmental Sciences 1-3 credits
Independent study on specialized topics under the direction of individual faculty members.

MEES708M Environmental Statistics II 3 credits PD or Elective
Instructor: D. Liang (CBL) and V. Lyubchich (CBL)
Frequency Offered: Every spring
This course will extend statistical training of the student to advanced topics of time series analysis and spatial statistics. After taking this course, students will be familiar with a variety of state-of-the-art approaches for qualitative analysis of time- and space-dependent data. Students will become competent users of these methods by practicing them in class and in their homework assignments using the statistical programming language R.

MEES708T Science Visualization 2 credits PD or Elective
Instructor: W. Dennison (HPL)
Frequency Offered: Even springs
Data visualization techniques, including conceptual diagrams, photographs, maps, graphs and tables will be taught by professional science communicators in the Integration and Application Network, University of Maryland Center for Environmental Science. Promotes the development of applied science visualization skills, including producing PowerPoint presentations, posters, and graphics for publication in a variety of media. Principles of good science visualization will be illustrated by case studies.

MEES708X R Programming - module 1 (basics) PD or elective
MEES708Y R Programming - module 2 (advanced)
Each module is 1 credit
Instructor: V. Lyubchich (CBL)
Frequency Offered: Even falls
Module 1 is for all new R users and Module 2 will build upon the basics learned in Module 1. No prior (R) programming experience is required. Through hands-on experience with examples, students will learn the basics of R language and related software. The goal is to train students in using R for their own research. We will start from foundations – installing R and getting data into it – and will continue with

blocks on data manipulation, visualization, writing reports and new functions. The course focuses on programming part (how to do this and that); however, R is a language for statistical computing, so some basic understanding of statistics is desired. Participants may need to consult a statistical text to interpret some of the results.

MEES712 Advanced Population Dynamics and Assessment 4 credits Elective

Instructor: M. Wilberg (CBL)

Frequency Offered: Odd springs

Management of exploited populations relies on a quantitative understanding of population dynamics and the effects of exploitation on marine resources. This course focuses on developing students' quantitative and modeling skills, including understanding of population dynamics and responses of populations to exploitation and management actions. The course covers population models of production, mortality, stock and recruitment, age and growth, and harvesting, and methods for using these models to provide management advice. Additionally, the course focuses on statistical model fitting and simulation.

MEES718(A-Z) Issue Study Groups 2 credits ISG

Instructor: Various

Frequency Offered: Every semester

Issue Study Groups (ISGs) are intended to allow students to get to grips with a very specific question, the resolution of which will require accessing, analyzing and synthesizing primary material to resolve or advance a problem. ISGs will often be topical, timely offerings that change over time in response to current scientific issues. ISGs are usually 2-credit courses that differ from traditional reading/discussion seminars in that they result in a clearly defined end product or public communication piece; e.g., a white paper, a peer-reviewed publication, a public presentation, a public database, or a novel communication product produced by the group.

MEES718W Classic Readings in Ecology 2 credits Elective

Instructor: K. Engelhardt (AL)

Frequency Offered: Even falls

Understanding the scientific concepts that are developed in classic ecological literature provides an anchor for understanding many recent ecological and environmental issues. The broad goal of this course is to discuss classic papers in ecology and relate them to contemporary concepts in marine, estuarine and environmental science. We will also talk to eminent ecologists and take a close look at the scientists behind the classics to learn about the creative process of science and the hurdles pioneers in science often have to overcome.

MEES743 Environmental Toxicology 3 credits Elective

Instructor: C. Mitchelmore (CBL)

Frequency Offered: Even springs

Basic concepts and principles of aquatic toxicology, laboratory testing and field situations, as well as examples of typical data and their interpretation and use by industry and water resources managers will

be discussed. Toxicological action and fate of environmental pollutants will be examined in aquatic ecosystems, whole organisms and at the cellular, biochemical, and molecular levels.

MEES799 Masters Thesis Research 1-6 Credits

Students seeking an M.S. degree must complete a minimum of 30 credits, with 6 of those being masters thesis research credits. Each faculty member is assigned a section number; students should sign up for their faculty advisor's section.

MEES898 Pre-Candidacy Research 1-8 Credits

Students seeking a Ph.D. must complete a minimum of 36 credits, with 12 of those being dissertation research credits. MEES898 is used for pre-candidacy research. Once a student advances to candidacy, the student will automatically be signed up for 6 credits of MEES899 doctoral dissertation research. Each faculty member is assigned a section number; students should sign up for their faculty advisor's section.

MEES899 Doctoral Dissertation Research 6 Credits

Students seeking a Ph.D. must complete a minimum of 36 credits, with 12 of those being dissertation research credits. MEES898 is used for pre-candidacy research. Once a student advances to candidacy, the student will automatically be signed up for 6 credits of MEES899 doctoral dissertation research during the spring and fall semesters.