

Mathematics/Science Electives
For
Mechanical Engineering Students

I Mathematics

MTH 301. Matrix Theory and Applications. 3 Hours

Investigation of systems of linear equations and matrices. Matrix operations, inverse matrix, partitioned matrices, matrix factorizations. Vector space and subspace of R^n . Null and Column spaces of matrices. Eigenvalues and eigenspaces of matrices. Orthogonal vectors, Least-Squares problems, Diagonalization, Quadratic forms, Singular value decompositions. Applications such as Markov chains, computer graphics, electric circuits, and image processing. Mathematics majors should take [MTH 310](#) rather than [MTH 301](#). Students cannot receive credit for both [MTH 301](#) and [MTH 310](#). **Prerequisite(s):** [MTH 218](#).

MTH 308 FOUNDATIONS AND DISCRETE MATHEMATICS 3 cr hr

An introduction to proof using topics in foundational and discrete mathematics; propositional logic; number theory; sequences and recursion; set theory; relations; combinatorics; linear programming.

Prerequisite(s): MTH 169.

MTH 310 LINEAR ALGEBRA AND MATRICES 3 cr hr

Fundamental concepts of vector spaces, determinants, linear transformations, matrices, inner product spaces, and eigen-vectors. Offered each term.

Prerequisite(s): (MTH 218, 308) or (MTH 218; permission of instructor). (May be taken as corequisites).

MTH 343 MATH FOR ELECTRICAL AND COMPUTER ENGINEERS 3 cr hr

Linear algebra and matrices, complex variables, mathematical transforms and their inter-relations. Focus on mathematical theories as well as applications and an extensive use of MATLAB.

Prerequisite(s): MTH 219.

MTH 367 STATISTICAL METHODS I 3 cr hr

Probability distributions including binomial, hypergeometric, Poisson, and normal. Estimation of population mean and standard deviation: Confidence intervals and tests of hypotheses using t-, Chi-square, and F-statistics. Mathematics majors enroll in MTH 411 instead of 367.

Prerequisite(s): MTH 149 or 169.

MTH 403 BOUNDARY VALUE PROBLEMS 3 cr hr

Introduction to the Sturm-Liouville problem. Fourier trigonometric series, Fourier integrals, Bessel functions, and Legendre polynomials. The heat equation, wave equation, and Laplace's equation with applications. Solutions by the product method.

Prerequisite(s): MTH 219.

MTH 404 COMPLEX VARIABLES 3 cr hr

Functions of a complex variable, conformal mapping, integration in the complex plane. Laurent series and residue theory.

Prerequisite(s): MTH 219.

MTH 440 INTRODUCTION TO MATHEMATICAL MODELING 3 cr hr

Introduction to the use of mathematical techniques and results in constructing and modifying models designed to solve problems encountered in everyday life. Computer simulation and limitations thereof, dimensional analysis, scaling, and approximations at various levels.

Prerequisite(s): MTH 219, 310; permission of instructor.

II. Biology

BIO 151 **CONCEPTS OF BIOLOGY I : CELL AND MOLECULAR BIOLOGY** 3 cr hr
Study of the molecular and cellular organization of organisms. Topics also include development and genetics. Core biology course.

BIO 152 **CONCEPTS OF BIOLOGY II : EVOLUTION AND ECOLOGY** 3 cr hr
Study of evolution and ecology. Topics include phylogeny, systematics, and conservation. Core biology course. BIO 151 recommended.

BIO 395. **GLOBAL ENVIRONMENTAL BIOLOGY** 3 cr hr
Presentation of the biological and ecological principles needed for critical discussion and evaluation of current global environmental issues including food production, human population growth, role of humans and pollution in environmental degradation, and conservation of agricultural, forest and other natural resources. No science credit for biology majors. Prerequisite(s): [BIO 101](#) or [SCI 190](#).

BIO 403 **PHYSIOLOGY 1** 3 cr hr
A physical-chemical examination of the physiological events occurring in a living system with emphasis on physiology of the cell, excretion, nerves, muscles, bone, blood, heart, circulation, and respiration.
Prerequisite(s): BIO 152; CHM 314 (Prerequisites: CHM 124, CHM 313)

BIO 475 **HUMAN ANATOMY** 3 cr hr
Study of the fundamental principles of human gross anatomy with emphasis on all organ systems.
Prerequisite(s): BIO 152; CHM 314. (Prerequisites: CHM 124, CHM 313)

III. Chemistry

CHM 124 **GENERAL CHEMISTRY** 3 cr hr
Comprehensive treatment of the fundamentals of general chemistry.
Prerequisite(s): CHM 123.

IV. Geology

GEO 208 **ENVIRONMENTAL GEOLOGY** 3 cr hr
Study of the relationship of geologic factors to the problems of water supply, pollution, erosion, land use, and earth resources. Laboratory optional.
Prerequisite(s): (GEO 109 or 115) or permission of instructor.

GEO 218 **ENGINEERING GEOLOGY** 3 cr hr
A comprehensive study of geologic principles applicable to civil engineering practices.

GEO 234 **ENERGY RESOURCES** 3 cr hr
The chemical and geological aspects of formation, production, and benefits/costs (including environmental impacts) of energy derived from fossil fuels (coal and hydrocarbons), biofuels (e.g., ethanol production), radioactive materials (nuclear power), and renewable sources (e.g., geothermal, hydro, wind, and solar power).

Prerequisite(s): CHM 123, 124.

Corequisite(s): GEO 208.

GEO 308 DECISIONS IN ENVIRONMENTAL GEOLOGY 3 cr hr

An in-depth examination of selected environmental problems and the way in which scientific information guides practice and policy. Topics will range from investigations of natural hazards to considerations of land use and water resources.

Prerequisite(s): (GEO 109 or 115) or permission of instructor.

GEO 309 SURFACE AND GROUND WATER HYDROLOGY 3 cr hr

This course is designed to provide a science or engineering student with the fundamental concepts and principles central to the study of water as a resource. This will include an examination of all components of the hydrologic cycle including surface-water hydrology and management, groundwater hydrogeology, and water resource management.

Prerequisite(s): (GEO 109 or 218) or permission of instructor.

GEO 412 INTRODUCTORY GEOCHEMISTRY 3 cr hr

Study of elementary thermodynamics, aqueous geochemistry, and principles governing the distribution of trace elements, radioisotopes and stable isotopes in igneous, metamorphic and sedimentary rocks. Emphasis on applications and solution of geological problems.

Prerequisite(s): GEO 201 or permission of instructor.

GEO 450 APPLIED GIS 3 cr hr

Concepts and implementation of project design and analysis in geographic information systems (GIS). Students will learn the practice of GIS as a tool for spatial analysis, and as it applies in professional disciplines. The course will stress database design and present skills for data input, query analysis, and data output using GIS.

GEO 455 ENVIRONMENTAL REMOTE SENSING 3 cr hr

Introduction to principles and concepts of remote sensing, a sophisticated technology of earth observation that provides fundamental data for global environmental investigation.

Prerequisite(s): GEO 208 or permission of instructor.

V. Physics

PHY 208 GENERAL PHYSICS III - MECHANICS OF WAVES 3 cr hr

Introduction to wave phenomena (including sound, light, and matter waves) leading to basic concepts in modern physics.

Prerequisite(s): (MTH 149; PHY 202) or (MTH 169; PHY 207).

PHY 220 ENERGY & ENVIRONMENTAL PHYSICS 3 cr hr

Introduction to the physical basis of energy systems and the climate. Topics covered will include thermodynamics, planetary radiation balance, heat transfer, basic atmospheric and ocean physics, nuclear energy, renewable energy, modeling of carbon emissions from fossil fuels, simple climate models, monitoring climate change, and mitigation strategies.

Prerequisite(s): PHY 206.

PHY 232 THE PHYSICS OF WAVES 3 cr hr

Physical concept and mathematical relations describing wave phenomena in a variety of physical systems. Topics include oscillation in mechanical and electrical systems, mechanical and electromagnetic waves, geometrical and physical optics and matter waves. Designed for electrical and computer engineering students, but open to all meeting the prerequisites.

Prerequisite(s): PHY 206; MTH 169 (may be taken as a corequisite).

PHY 321 ATOMIC AND NUCLEAR PHYSICS

3 cr hr

Concepts and models of the structure of matter; atoms, ions, electrons and nuclei, radioactivity, interactions of radiation with matter, particle detection, accelerators, nuclear models, nuclear reactions and processes, and fundamental particles.

Prerequisite(s): (PHY 208 or 232) or permission of instructor.

VI. Health and Sports Sciences

HSS 305 HUMAN ANATOMY

3 cr hr

Study of the human body with emphasis on the interdependent relationships of structure and function.

Prerequisite(s): (BIO 151/151L and 152/152L), (CHM 123/123L and 124/124L), MTH 148 or permission of instructor

This course is for those students interested in bioengineering, see Professor Kim Bigelow.

VII. Integrated Natural Science

SCI 210 THE DYNAMIC EARTH

An introduction to the earth system and the processes that operate in the atmosphere, hydrosphere, biosphere, and solid Earth. Emphasis is placed on understanding how interactions among these fundamental Earth systems maintain our livable planet. Prerequisite(s): SCI 190.

SCI 220 WORLD OF CHEMISTRY

Introduction to the experimental nature of chemistry. Attention is focused on the microscopic view of matter, addressing topics that lead into the study of biological chemistry. Prerequisite(s): SCI 190.

SCI 230 ORGANISMS, EVOLUTION AND ENVIRONMENT

An evolutionary approach to the relationship between living organisms and their environments. This survey of basic concepts in biology continues the evolutionary theme of the two prerequisite courses.

Prerequisite(s): (SCI 190, SCI 210) or permission of instructor.

SCI 240 ORGANISMS, EVOLUTION AND HEALTH

Biology with an emphasis on biomedical science and a focus on human health and disease. Prerequisite(s): (SCI 190, SCI 220) or permission of instructor.

SCI 310 EARTH AND SKY

No description available

VIII. Sustainability, Energy and Environment

SEE 301 GLOBAL CHANGE AND EARTH SYSTEMS

3 cr hr

A multidisciplinary introduction to the science of the earth system. Focus is on the interrelatedness of geological, biological, chemical and physical processes, and on methods used to understand both the past natural history and potential future scenarios for change in the earth system.

Corequisite(s): BIO 101, SCI 230, or equivalent.