## GEOLOGY AND GEOPHYSICS (GEOS)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Offered</th>
<th>Prerequisites</th>
<th>Lecture + Lab + Other</th>
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<tbody>
<tr>
<td>GEOS F101L</td>
<td>GEOS F101X Laboratory</td>
<td>0</td>
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<tr>
<td>GEOS F101X</td>
<td>The Dynamic Earth</td>
<td>4</td>
<td>Offered Fall and Spring</td>
<td>Co-requisites: GEOS F101X.</td>
<td>3 + 3 + 0</td>
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<tr>
<td>GEOS F106X</td>
<td>Life in the Age of Dinosaurs</td>
<td>4</td>
<td>Offered Spring Even-numbered Years</td>
<td>Co-requisites: GEOS F101L. Placement in WRTG F111X; placement in MATH F105.</td>
<td>3 + 3 + 0</td>
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<td>GEOS F112L</td>
<td>GEOS F112X Laboratory</td>
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<tr>
<td>GEOS F112X</td>
<td>The History of Earth and Life</td>
<td>4</td>
<td>Offered Spring</td>
<td>Co-requisites: GEOS F112L. Placement in WRTG F111X; placement in MATH F105.</td>
<td>3 + 3 + 0</td>
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<tr>
<td>GEOS F119</td>
<td>Glaciers, Earthquakes and Volcanoes: Past, Present and Future</td>
<td>3</td>
<td>Offered Fall and Spring</td>
<td>Co-requisites: GEOS F112L. Placement in WRTG F111X; placement in MATH F105.</td>
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<td>GEOS F120L</td>
<td>GEOS F120X Laboratory</td>
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<td>GEOS F120X</td>
<td>Glaciers, Earthquakes and Volcanoes: Past, Present and Future</td>
<td>4</td>
<td>Offered Fall and Spring</td>
<td>Co-requisites: GEOS F120L. Placement in WRTG F111X; placement in MATH F105.</td>
<td>3 + 3 + 0</td>
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<tr>
<td>GEOS F190</td>
<td>The Geology of Wine</td>
<td>2</td>
<td>Offered Spring Even-numbered Years</td>
<td>Co-requisites: GEOS F112L. Placement in WRTG F111X; placement in MATH F105.</td>
<td>1.5 + 0.5 + 0</td>
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<tr>
<td>GEOS F192</td>
<td>Seminar</td>
<td>1-6</td>
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<td>0 + 0 + 0</td>
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<tr>
<td>GEOS F212</td>
<td>Geology of Alaska</td>
<td>3</td>
<td>Offered As Demand Warrants</td>
<td>Prerequisites: GEOS F101X. Placement in WRTG F111X; placement in MATH F105.</td>
<td>3 + 0 + 0</td>
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<td>Course Code</td>
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<td>Offered Years</td>
<td>Prerequisites</td>
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<tr>
<td>GEOS F213</td>
<td>Mineralogy</td>
<td>4</td>
<td>Fall</td>
<td>Mineral chemistry, atomic structure, elementary crystallography, optical crystallography and descriptive and determinative mineralogy. Instrumental determinative techniques (x-ray diffraction, petrographic microscope). Prerequisites: MATH F151X (may be taken concurrently); CHEM F105X; GEOS F101X. Lecture + Lab + Other: 2 + 6 + 0</td>
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<tr>
<td>GEOS F214</td>
<td>Petrology and Petrography</td>
<td>4</td>
<td>Spring</td>
<td>Origin, occurrence and classification of igneous and metamorphic rocks. Laboratory work involves hand lens identification and thin section examination of representative rocks. Prerequisites: GEOS F213. Lecture + Lab + Other: 2 + 6 + 0</td>
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<tr>
<td>GEOS F222</td>
<td>Fundamentals of Geospatial Science</td>
<td>3</td>
<td>As Demand Warrants</td>
<td>This course is an introduction to the principles and applications of geospatial science (remote sensing, GIS and GPS). Fundamental concepts include electromagnetic radiations, map projections, basic computer science, data formats, map-reading and map-making, etc. Practical exercises include field data collections using GPS, photo-interpretation using image processing and GIS software packages. Prerequisites: GEOG F111X or GEOS F101X. Cross-listed with GEOG F222. Lecture + Lab + Other: 2.5 + 1.5 + 0</td>
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<tr>
<td>GEOS F225</td>
<td>Field and Computer Methods in Geology</td>
<td>2</td>
<td>Spring</td>
<td>Basic field methods, including field notes, topographic maps, measurement of structural elements, field safety, illustration, field mapping, and the use of GPS for field work are discussed and practiced. Use of computers for processing geologic field data and analytical data, and integration of field data into a simple Geographic Information System. Computers are used for the production of reports and technical illustration. This course will fulfill the department requirement for computer literacy. Prerequisites: GEOS F214 or GEOS F262 (may be taken concurrently). Lecture + Lab + Other: 1 + 3 + 0</td>
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<td>GEOS F252</td>
<td>Volcanism and Active Geology of the Island of Hawai'i</td>
<td>2</td>
<td>As Demand Warrants</td>
<td>A field-based course introducing students to the volcanism and active geology of the island of Hawai‘i, and by extension, other oceanic islands. Topics include physical features of the volcanoes, plate tectonics and the origin of volcanism, and the development and ‘life cycle’ of oceanic islands. Students cannot take both GEOS F252 and GEOS F352 for credit. Prerequisites: GEOS F101X, GEOG F111X. Crosslisted with GEOG F308. Lecture + Lab + Other: 7.5 + 25 + 0</td>
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<td>GEOS F262</td>
<td>Rocks and Minerals</td>
<td>3</td>
<td>Fall</td>
<td>Physical properties of minerals and rocks, classification, mode of occurrence and economic applications. Labs on recognition and measurement of physical properties. Course may not be used to satisfy degree requirements in geology or geological engineering. Prerequisites: GE F261, GEOS F101X. Lecture + Lab + Other: 2 + 3 + 0</td>
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<td>GEOS F292</td>
<td>Seminar</td>
<td>1-6</td>
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<td>Supervised pre-professional experience in a business or agency (public or private). Course may be repeated for credit up to a maximum of 6 credits. Prerequisites: Junior or Senior standing with 3.0 GPA; an internship plan approved by the intern’s faculty supervisor. Cross-listed with GEOG F300. Lecture + Lab + Other: 1-6 + 0 + 0</td>
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<td>GEOS F300</td>
<td>Internship in Geography or Geoscience</td>
<td>1-3</td>
<td>Fall, Spring and Summer</td>
<td>In-depth examination of the natural, political, cultural, and economic characteristics of the U.S. and Canada and their major sub-regions. Explores contrasts in U.S. and Canadian historical, cultural and political geography; sources of national identity; and interactions with aboriginal peoples. Includes economic and political relationships between the two countries, and the role each has played in current and historical world affairs. Prerequisites: An introductory geography course or background in United States or Canadian history, social science, or cultures. Crosslisted with GEOG F303. Lecture + Lab + Other: 0 + 0 + 3-10</td>
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<tr>
<td>GEOS F303</td>
<td>Geography of United States and Canada</td>
<td>3</td>
<td>Fall</td>
<td>In-depth examination of the natural, political, cultural, and economic characteristics of the U.S. and Canada and their major sub-regions. Explores contrasts in U.S. and Canadian historical, cultural and political geography; sources of national identity; and interactions with aboriginal peoples. Includes economic and political relationships between the two countries, and the role each has played in current and historical world affairs. Prerequisites: An introductory geography course or background in United States or Canadian history, social science, or cultures. Crosslisted with GEOG F303. Lecture + Lab + Other: 3 + 0 + 0</td>
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<td>GEOS F304</td>
<td>Geomorphology</td>
<td>3</td>
<td>Fall</td>
<td>Surface features of the Earth and the processes which create or modify them. Application to Quaternary history, environmental science and related fields. Laboratory examination of topographic maps and aerial photographs, introduction to geomorphic measurements. Prerequisites: GEOS F101X, GEOG F111X. Crosslisted with GEOG F308. Lecture + Lab + Other: 3 + 0 + 0</td>
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GEOS F309  Tectonics (W)  
3 Credits  
Offered Fall  
In-depth exploration of the theory of Plate Tectonics including plate boundary interactions—which trigger volcanoes and earthquakes, form mountain belts and oceans—via geochemistry, sedimentology, geophysics and structure. Understanding the creation and evolution of the lithosphere and mantle, how we detect tectonic processes and how present tectonic environments help reconstruct ancient crustal events.  
**Prerequisites:** WRTG F211X, WRTG F212X, WRTG F213X or WRTG F214X; GEOS F112X; GEOS F214 or GEOS F262 (either may be taken concurrently).  
Lecture + Lab + Other: 3 + 0 + 0

GEOS F310  Digital Cartography and Geovisualization (s)  
4 Credits  
Offered As Demand Warrants  
The concepts of map design, layout and presentation to effectively visualize and communicate complex spatial data.  
**Prerequisites:** Permission of instructor.  
Cross-listed with GEOG F310.  
Lecture + Lab + Other: 3 + 3 + 0

GEOS F314  Structural Geology (n)  
4 Credits  
Offered Spring  
Introductory overview of how rocks are deformed, types of geological structures including folds, faults and penetrative fabrics, and the associations of structures characteristic of different tectonic settings. Provides background in structural geology. Emphasis in the laboratory on examples and techniques that are broadly applicable in geology, especially the interpretation of geologic maps.  
**Prerequisites:** GEOS F320, GEOS F322 or GEOS F214 (GEOS F214 may be taken concurrently); MATH F152X; PHYS F123X or PHYS F211X.  
Lecture + Lab + Other: 3 + 3 + 0

GEOS F315  Paleobiology and Paleontology (W, n)  
4 Credits  
Offered Fall  
Survey of the history of life on Earth as represented in the fossil record. Contribution of paleontology to the study of evolution, past environments and paleogeography; biostratigraphically important invertebrate fossil groups and their temporal ranges; evolution of terrestrial flora and fauna; current issues in paleontology. Emphasis on recognition of major fossil groups and paleontological problem-solving in labs and assignments.  
**Prerequisites:** BIOL F103X or BIOL F115X or GEOS F112X; WRTG F111X; WRTG F211X, WRTG F212X, WRTG F213X or WRTG F214X.  
Lecture + Lab + Other: 3 + 3 + 0

GEOS F317  Paleontological Research and Laboratory Methods (O)  
2 Credits  
Offered Spring Even-numbered Years  
Introduction to the research methods in paleontology. This course covers the fundamentals of fossil preparation, digital techniques for imaging and analyzing paleontological data, and discusses the current theory and practice of curation of fossil material in a museum setting. Common techniques for presenting research results to a scientific and public audience are also covered, with an emphasis on oral presentations. Labs emphasize practical experiences in the methods and presentation of research.  
**Prerequisites:** GEOS F101X and GEOS F112X.  
Lecture + Lab + Other: 1 + 3 + 0

GEOS F320  Sedimentology for Geological Engineers  
3 Credits  
Offered Fall  
Origin, classification, composition, transportation, deposition and diagenesis of sediments. Emphasis on sedimentary processes, sedimentary petrology and interpretation of ancient sedimentary rocks. Laboratory covers identification and description of hand specimens as well as techniques of textural and compositional analysis. Not intended for geoscience majors and does not substitute for GEOS F322. Special fees apply.  
**Corequisites:** GEOS F213.  
Lecture + Lab + Other: 2 + 3 + 0

GEOS F322  Stratigraphy and Sedimentation (n)  
4 Credits  
Offered Fall  
Analysis and interpretation of sedimentary rocks in stratigraphic successions based on comparison with features found in modern depositional environments. Application of the principles of facies analysis and litho-, bio-, sequence, and chronostratigraphy in surface and subsurface examples. Emphasis in the laboratory on interpretation of depositional environments based on lithofacies, biofacies and sedimentary structures and correlation of stratigraphic sequences using surface and subsurface data.  
**Prerequisites:** GEOS F101X or GE F261; GEOS F112X.  
Lecture + Lab + Other: 3 + 3 + 0

GEOS F332  Ore Deposits and Structure  
3 Credits  
Offered Spring  
Distribution and characteristics (especially mineralogy, morphology, and structure) of major mineral deposit types with background on structural techniques. Emphasis on application to mineral exploration and development. Laboratory exercises stress recognition of major mineral deposit types, zoning and grade patterns; and use of structural techniques in mineral deposit exploration/development.  
**Prerequisites:** GEOS F262 or GEOS F213 and GEOS F214.  
Lecture + Lab + Other: 1 + 6 + 0

GEOS F339  Change Detection in Arctic Systems (n, n, a)  
4 Credits  
Offered Spring Odd-numbered Years  
This course focuses on methods for measuring landscape change within Arctic Systems as well as the geomorphology of glacial landforms. A semester long research project, field and lab based activities, and a field trip will provide opportunities to learn about and experience the application of a variety of technologies.  
**Prerequisites:** GEOG F111X or GEOS F101X; NRM F338.  
Cross-listed with GEOG F339.  
Lecture + Lab + Other: 1 + 3 + 0

GEOS F352  Volcanism and Active Geology of the Island of Hawai‘i  
2 Credits  
Offered As Demand Warrants  
A field-based course introducing students to the volcanism and active geology of the island of Hawaii, and by extension, other oceanic islands. Topics include physical features of the volcanoes, plate tectonics and the origin of volcanism, and the development and 'life cycle' of oceanic islands. Students cannot take both GEOS F252 and GEOS F352 for credit.  
**Prerequisites:** GEOS F213 or GEOS F262; GEOS F214, GEOS F222 or GEOS F225.  
Stacked with GEOS F252.  
Lecture + Lab + Other: 7.5 + 25 + 0
GEOS F370  Sedimentary and Structural Geology for Petroleum Engineers  (n)
4 Credits
Offered Fall Odd-numbered Years
Origin and distribution of sedimentary rocks including depositional environments, stratigraphic relationships and structures. Emphasis on the relationship to petroleum occurrences and petroleum exploration. Laboratory exercises on mapping, structural problems and facies relationships in petroleum exploration.
Prerequisites: GEOS F101X or GE F261.
Cross-listed with PETE F370.
Lecture + Lab + Other: 3 + 3 + 0

GEOS F375  Oral Communication Skills for Geoscientists
1 Credit
Offered As Demand Warrants
This course will give you skills and practice in oral communication, especially as applied to professional geology. The course will provide a comfortable environment for students to develop and improve their skills both in creating and delivering oral presentations. The specific focus will vary with the instructor.
Prerequisites: COJO F131X or COJO F141X; GEOS F225; junior standing.
Lecture + Lab + Other: 0.5 + 0 + 1.5

GEOS F380  Geological Hazards
3 Credits
Offered Spring
Survey of natural hazards and the disasters they cause, with emphasis on geological hazards in Alaska. Investigation of hazardous phenomena, prediction and mitigation. Topics to include: earthquakes, volcanoes, tsunamis, weather/climate, and asteroid impacts. Provides a foundation in basic geological hazards related to science, suitable for use in teaching, communications, policy and emergency management careers.
Prerequisites: GEOS F101X or GEOS F120X or GEOS F106X.
Lecture + Lab + Other: 3 + 0 + 0

GEOS F392  Seminar
1-6 Credits
Lecture + Lab + Other: 0 + 0 + 0

GEOS F392P  Seminar
1-6 Credits
Lecture + Lab + Other: 1-6 + 6 + 0

GEOS F398  Research
1-6 Credits
Lecture + Lab + Other: 0 + 0 + 0

GEOS F401  Invertebrate Paleontology  (n)
3 Credits
Offered Fall Even-numbered Years
Study of invertebrate phyla with extensive geologic records. Emphasis on principles of biostatigraphy and paleoecology, application to geologic problems and case studies from Alaska. Laboratory study of fossil assemblages with emphasis on stratigraphically significant groups. Designed to complement GEOS F322.
Prerequisites: GEOS F315.
Recommended: GEOS F322.
Lecture + Lab + Other: 2 + 3 + 0

GEOS F406  Volcanology
3 Credits
Offered Spring Odd-numbered Years
Physical processes of volcanism. Topics include physical properties of magmas, eruption mechanisms, deposition mechanism and volcanic hazards. Emphasis on explosive volcanism and its products, pyroclastic rocks. Geochemistry and petrology will not be emphasized in this course.
Prerequisites: GEOS F101X or GEOS F120X; MATH F251X; PHYS F211X.
Stacked with GEOS F606.
Lecture + Lab + Other: 3 + 0 + 0

GEOS F416  Applied Geophysics
3 Credits
Offered Spring Even-numbered Years
Introduction to the theory and practice of geophysical techniques and the interpretation and modeling of geophysical data. Topics include: gravity, GPS, magnetic seismic, and electrical methods and their application to regional and local geophysical exploration in Alaska.
Prerequisites: GEOS F419.
Lecture + Lab + Other: 2 + 3 + 0

GEOS F417  Introduction to Geochemistry  (n)
3 Credits
Offered Fall
Application of chemical principles and elemental/isotopic behavior to the study of the Earth. Topics include: aqueous geochemistry, high-temperature mineral-elemental chemistry, isotopic chemistry, kinetics and thermochemistry.
Prerequisites: CHEM F106X; GEOS F322 or CHEM F202.
Stacked with GEOS F618.
Lecture + Lab + Other: 3 + 0 + 0

GEOS F419  Solid Earth Geophysics
3 Credits
Offered Fall Odd-numbered Years
Concepts and techniques of geophysics including origin of the Earth, its structure and large scale dynamic processes responsible for its surface features. Geophysical techniques including seismology, gravity and magnetic methods are discussed along with measurements of the Earth's thermal structure, rotation rates, and tidal effects.
Prerequisites: MATH F251X; PHYS F124X.
Lecture + Lab + Other: 3 + 0 + 0

GEOS F422  Geoscience Applications of Remote Sensing  (n)
3 Credits
Offered As Demand Warrants
Remote sensing and its applications to geologic, environmental and physical sciences. Includes physical principles, digital image processing and hands-on project experience using satellite images for mapping and change detection. Course is not available for audit.
Prerequisites: PHYS F124X or PHYS F212X; junior standing.
Cross-listed with GEOG F422.
Lecture + Lab + Other: 2 + 3 + 0
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<th>Course</th>
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<tr>
<td>GEOS F423</td>
<td>Geopolitics of Energy</td>
<td>3</td>
<td>Fall Odd-numbered</td>
<td>One of the following courses: GEOG F101X, GEOG F312, GEOG F405, GEOG F101X, NRM F101, NRM F403, PS F201X, PS F221X, PS F304, PS F323, ECON F235X, ECON F335, ECON F439 or ECON F463; junior standing.</td>
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<td>Lecture + Lab + Other: 3 + 0 + 0</td>
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<tr>
<td>GEOS F424</td>
<td>International Volcanological Field School</td>
<td>3</td>
<td>Summer</td>
<td>A field-based course that takes students to designated volcanoes and provides an opportunity to learn about volcanic processes through direct examination of volcanic products. Specific location to be announced at registration. Course may be repeated for credit when location varies. Students registering for the class must complete the course application and provide a reference letter.</td>
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<td>Prerequisites: application required, permission of instructor, appropriate background in Geology, Chemistry and Physics.</td>
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<td>Special Notes: Students must be in good health, capable of hiking for at least 20 km per day carrying heavy backpacks, and be willing to camp under primitive, remote and possibly uncomfortable conditions.</td>
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<td>Lecture + Lab + Other: 2 + 1 + 0</td>
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<tr>
<td>GEOS F428</td>
<td>Elementary Scanning Electron Microscopy</td>
<td>1</td>
<td>Spring</td>
<td>Basic theory and operating procedures for scanning electron microscopy. Includes sample preparation, imaging and qualitative elemental analysis. Biological and nonbiological applications are covered.</td>
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<td>Prerequisites: Junior standing.</td>
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<td>Stacked with GEOS F628.</td>
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<td>Lecture + Lab + Other: 0.5 + 1.5 + 0</td>
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<td>GEOS F429</td>
<td>Geography of the Arctic and Circumpolar North          (s, a)</td>
<td>3</td>
<td>Fall</td>
<td>An in-depth examination of the physical, cultural, social, political and economic geographies of the Circumpolar North. Special emphasis on the patterns and processes of contemporary environmental change, human adaptations to high latitude environments, Arctic geopolitics and security, and the spatial patterns of northern economic development.</td>
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<td>Prerequisites: GEOG F101X or GEOG F111X.</td>
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<td>Cross-listed with ACNS F429; GEOG F429.</td>
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<td>Stacked with ACNS F629; GEOG F629.</td>
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<td>Lecture + Lab + Other: 3 + 0 + 0</td>
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<td>GEOS F430</td>
<td>Statistics and Data Analysis in Geology</td>
<td>3</td>
<td>Spring</td>
<td>Computer-supported geologic applications of elementary statistics, Markov chains, time-series analysis, trend-surface analysis, factor analysis, cluster analysis, discriminant analysis, and multiple regression.</td>
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<td>Prerequisites: GEO F225; STAT F200X.</td>
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<td>GEOS F431</td>
<td>Foundations of Geophysics</td>
<td>4</td>
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<td>Applications of continuum mechanics, heat flow theory, and potential theory to geophysical, geologic and glaciological problems. Topics such as postglacial rebound, non-Newtonian fluid flow, thermal convection, stress-relaxation, rheology of earth materials, gravity, and magnetics will be discussed. Emphasis will be placed on methods and tools for solving a variety of problems in global and regional geophysics and the geophysical interpretation of solutions.</td>
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<td>Prerequisites: GEO F419, MATH F302, and MATH F314.</td>
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<td>Lecture + Lab + Other: 3 + 3 + 0</td>
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<tr>
<td>GEOS F436</td>
<td>Beyond the Mouse: Computer Programming and</td>
<td>2</td>
<td>Fall</td>
<td>Basic concepts of computer programming and effective automation of tasks using a computer, with an emphasis on tools and problems common to the geosciences and other physical sciences. Use of MATLAB, shell scripting and various command line tools for data analysis, making scientific figures, maps and visualizations.</td>
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<td>Automation for Geoscientists</td>
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<td>Prerequisites: Senior standing.</td>
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<td>Lecture + Lab + Other: 1 + 3 + 0</td>
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<tr>
<td>GEOS F438</td>
<td>Basin Analysis</td>
<td>3</td>
<td>As Demand Warrants</td>
<td>Examines sedimentary basins as a record of subsidence. Review and discuss techniques used to image basin stratigraphy as well as the quantitative techniques which can be used to recover basin history.</td>
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<td>Prerequisites: GEO F322 or GEO F370.</td>
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<td>Recommended: GEOS F314; GEO F419.</td>
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<td>GEOS F445</td>
<td>Petroleum Geology</td>
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<td>Examines the origin of petroleum, the geologic controls of its distribution and accumulation and the basic tools used in exploration and exploitation, including subsurface mapping, well logging and exploration geophysics.</td>
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GEOS F452  Quaternary Seminar  
3 Credits  
Offered As Demand Warrants  
Discussion of the Quaternary Period (relatively recent past – spanning the past two million years) in order to gain a better understanding of the landscape, biota and climate of the present day. Quaternary studies are concerned with the historical dimension of the natural sciences. This seminar will range widely over diverse interdisciplinary subjects of Quaternary interest, such as paleoclimatology, paleobiogeography, vertebrate paleontology and sedimentology.  
Prerequisites: GEOS F304; GEOS F315; GEOS F322.  
Cross-listed with ANTH F451.  
Stacked with GEOS F651; ANTH F651.  
Lecture + Lab + Other: 3 + 0 + 0

GEOS F453  Palynology and Paleopalynology  
4 Credits  
Offered Fall Even-numbered Years  
Survey of the evolutionary record of palynomorphs and their uses in biostratigraphy and paleoclimatology. Focus on evolution of palynomorphs from Precambrian to the present and concurrent evolutionary developments of producing plants. Use of Quaternary palynofloras in reconstructing global climates. Labs involve collection of herbarium specimens, processing of fossil palynomorphs, study of type slides and a survey of palynofloras from each geologic period.  
Prerequisites: BIOL F115X or GEOS F315; senior standing.  
Stacked with GEOS F653.  
Lecture + Lab + Other: 3 + 3 + 0

GEOS F454  Field Geology  
8 Credits  
Offered Summer Odd-numbered Years  
Practical experience in a variety of field settings collecting and presenting basic geologic field data. Includes field mapping of stratigraphic and structural problems using topographic maps, airborne and satellite images. Students will prepare geologic maps in a variety of tectonic and lithologic settings and develop written reports detailing the geologic history for several study areas. Exercises in collection and use of geophysical data as an aid to geologic mapping. Hiking off trails in a variety of terrains with up to 2,000 vertical feet of elevation gain per day. Course fees cover transportation and subsistence outside of Fairbanks. Entrance by preregistration only; apply through the department. Early registration recommended.  
Prerequisites: GEOS F214; GEOS F225; GEOS F309; GEOS F314; GEOS F315; GEOS F322.  
Lecture + Lab + Other: 8 + 0 + 0

GEOS F456  Paleopedology  
3 Credits  
Offered As Demand Warrants  
A survey course focusing on the recognition and use of paleosols (fossil soils) as paleoenvironmental indicators, stratigraphic markers and in paleogeographic reconstructions from Precambrian to Holocene. Examination of theories of soil formation, major soil processes and approaches to soil classification. Review of geochemical, mineralogical, morphological and micromorphological techniques. Use of paleosols for paleolandcape evolution and basin analysis. Geological, tectonic, archaeological and environmental applications of paleosols are discussed.  
Prerequisites: GEOS F322 or NRM F380.  
Stacked with GEOS F656.  
Lecture + Lab + Other: 3 + 0 + 0

GEOS F458  Applications of GPS and GIS in Geophysics  
3 Credits  
Offered As Demand Warrants  
Prerequisites: GEOG F338 or NRM F338.  
Cross-listed with GEOG F458.  
Stacked with GEOS F658.  
Lecture + Lab + Other: 2 + 3 + 0

GEOS F460  The Dynamic Alaska Coastline  
3 Credits  
Offered Spring Even-numbered Years  
Alaska’s diverse coastal system provides abundant ecosystem services and globally important resources. This course provides an interdisciplinary perspective on the dynamic coastal landscape of Alaska from Southcentral to the Arctic, and delves into the driving geological, oceanographic and climate processes shaping Alaska’s past and present coastline. Through a semester long research projects students will learn how to measure and map coastal changes associated with natural and human perturbations. An overnight field trip will serve as an active learning opportunity to integrate course knowledge with hands-on field work.  
Prerequisites: Junior standing; GEOG F111X or GEOS F101X; CHEM F105X or PHYS F123X; NRM F338 or equivalent GIS coursework.  
Cross-listed with GEOG F460.  
Stacked with GEOS F660; GEOG F660.  
Lecture + Lab + Other: 3 + 0 + 0

GEOS F463  Glacial and Periglacial Geology  
4 Credits  
Offered As Demand Warrants  
Prerequisites: COJO F131X or COJO F141X; GEOS F304.  
Stacked with GEOS F663.  
Lecture + Lab + Other: 3 + 3 + 0

GEOS F465  Geoarchaeology  
3 Credits  
Offered As Demand Warrants  
Geological context of archaeological sites and the geologic factors that affect their preservation, with emphasis on Alaska. Includes a one or two-day weekend field trip in late April or early May.  
Prerequisites: GEOS F101X; an introductory course in archaeology.  
Cross-listed with ANTH F465.  
Lecture + Lab + Other: 3 + 0 + 0
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<td>GEOS F485</td>
<td>Mass Extinctions, Neocatastrophism and the History</td>
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<td>GEOS F488P</td>
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<td>As Demand Warrants</td>
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**Prerequisites:**
- GEOS F475: COJO F131X or COJO F141X; WRTG F111X, WRTG F211X, WRTG F212X, WRTG F213X or WRTG F214X; senior standing.
- GEOS F477: Cross-listed with ATM F480, GEOG F480.
- GEOS F480: Cross-listed with ATM F480, GEOG F480.
- GEOS F488: Cross-listed with BIOL F486, BIOL F686.
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<td>Introduction to X-ray Spectrometry</td>
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<td>GEOS F602</td>
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**Special Notes:** Course may be repeated for different topics up to three times for credit.

**Cross-listed with:** PHYS F614.
GEOS F615  Sea Ice  (a)  
3 Credits  
Offered As Demand Warrants  
A study of sea ice in the natural environment including sea ice properties and processes on the micro-scale and the macro-scale, freezing processes and sea ice growth, ice decay and ice dynamics.  
Prerequisites: Graduate standing.  
Lecture + Lab + Other: 3 + 0 + 0  

GEOS F616  Permafrost  (a)  
3 Credits  
Offered Spring Odd-numbered Years  
Study of the occurrence, thickness, environmental problems, and mass and energy transport of permafrost, including soil and ice interaction, freezing and thawing processes, and mechanical and electrical properties and processes.  
Prerequisites: Graduate standing.  
Lecture + Lab + Other: 3 + 0 + 0  

GEOS F617  Glaciers  (a)  
3 Credits  
Offered Fall Odd-numbered Years  
The mechanisms responsible for the existence, motion and variations of present-day glaciers and ice sheets, the paleoclimate information they contain and their role in engineering hydrology.  
Prerequisites: Graduate standing.  
Lecture + Lab + Other: 3 + 0 + 0  

GEOS F618  Introduction to Geochemistry  
3 Credits  
Offered Fall  
Application of chemical principles and elemental/isotopic behavior to study of the Earth. Topics include: aqueous geochemistry, high-temperature mineral-elemental chemistry, isotopic chemistry, kinetics and thermochemistry.  
Prerequisites: CHEM F106X; GEOS F322 OR CHEM F331 and CHEM F332; graduate standing.  
Stacked with GEOS F417.  
Lecture + Lab + Other: 3 + 0 + 0  

GEOS F619  Advanced X-ray Spectroscopy  
2 Credits  
Offered As Demand Warrants  
Advanced X-ray techniques. Topics include preparation of unusual samples, quantification methods, x-ray mapping and classification, and error analysis. Each student will develop a project to explore the limits of x-ray analysis.  
Prerequisites: GEOS F600.  
Special Notes: Course may be repeated three times for credit.  
Lecture + Lab + Other: 1 + 3 + 0  

GEOS F620  Geodynamics  
3 Credits  
Offered Fall Even-numbered Years  
Applications of continuum mechanics and heat flow theory to geophysical, geologic and glaciological problems. Topics such as postglacial rebound, non-Newtonian fluid flow, thermal convection, stress-relaxation and the rheology of earth materials will be discussed.  
Prerequisites: MATH F410 and MATH F432; OR graduate standing.  
Lecture + Lab + Other: 3 + 0 + 0  

GEOS F621  Advanced Petrology  
4 Credits  
Offered Spring  
A detailed treatment of various aspects of petrology. Specific topics to be considered in different semesters include metamorphic petrology, igneous petrology, and igneous and metamorphic petrography. Each time the course is offered, only one topic will be presented.  
Prerequisites: Graduate standing.  
Lecture + Lab + Other: 3 + 3 + 0  

GEOS F621B  Adv Petrology: Igneous Petrology  
3-4 Credits  
Offered Fall  
Lecture + Lab + Other: 2-3 + 3-6 + 0  

GEOS F621C  Advanced Petrology  
3-4 Credits  
Offered Fall  
Lecture + Lab + Other: 2-3 + 3-6 + 0  

GEOS F622  Digital Image Processing in the Geosciences  
3 Credits  
Offered Fall Odd-numbered Years  
Image processing and analysis techniques as they relate to remote sensing and other applications in the geosciences. Apart from lectures and demonstrations, the advantages and drawbacks of different methods and approaches and their applicability to geoscience problems will be evaluated through exercises and a course project.  
Lecture + Lab + Other: 3 + 0 + 0  

GEOS F624  International Volcanological Field School  (a)  
3 Credits  
Offered Summer  
A field-based course that takes students to designated volcanoes and provides an opportunity to learn about volcanic processes through direct examination of volcanic products. Specific location to be announced at registration. Course may be repeated for credit when location varies. Students registering for the class must complete the course application and provide a reference letter.  
Prerequisites: graduate standing in volcanology.  
Stacked with GEOS F424.  
Special Notes: Students must be in good health, capable of hiking for at least 20 km per day carrying heavy backpacks, and be willing to camp under primitive, remote and possibly uncomfortable conditions.  
Lecture + Lab + Other: 2 + 1 + 0  

GEOS F626  Applied Seismology  
4 Credits  
Offered Spring Even-numbered Years  
Presentation of modeling techniques for earthquakes and Earth structure using wave propagation algorithms and real seismic data. Covers several essential theories and algorithms for applications in seismology, as well as the basic tools needed for processing and using recorded seismograms. Topics include the seismic waveform (body waves and surface waves), earthquake moment tensors, earthquake location and seismic tomography. Assignments require familiarity with vector calculus, linear algebra and computational tools such as Matlab.  
Prerequisites: MATH F253X; MATH F314.  
Lecture + Lab + Other: 3 + 3 + 0
GEOS F627  Inverse Problems and Parameter Estimation  
3 Credits  
Offered Spring Odd-numbered Years  
An inverse problem uses observations to infer properties of an unknown physical model. One example is how seismometer recordings can be used to infer the location of an earthquake. This course covers inverse theory and methods for solving inverse problems, including numerous examples arising in the natural sciences. Topics include linear regression, method of least squares, discrete ill-posed inverse problems, estimation of uncertainties, iterative optimization, and probabilistic (Bayesian) and sampling approaches. Assignments and computational laboratory exercises require familiarity with linear algebra and computational tools such as Matlab.  
Prerequisites: MATH F253X; MATH F314.  
Cross-listed with PHYS F625.  
Lecture + Lab + Other: 2 + 3 + 0

GEOS F628  Elementary Scanning Electron Microscopy  
1 Credit  
Offered Spring  
Basic theory and operating procedures for scanning electron microscopy. Includes sample preparation, imaging and qualitative elemental analysis. Biological and nonbiological applications are covered.  
Prerequisites: Graduate standing.  
Stacked with GEOS F428.  
Lecture + Lab + Other: 0.5 + 1.5 + 0

GEOS F629  Geologic Hazards and Natural Disasters  
3 Credits  
Offered Spring Odd-numbered Years  
Examination of hazardous geologic processes which produce natural disasters, including volcanism, tectonism, flooding, etc. Includes scientific approaches to evaluating the magnitude and probability of risk from future hazardous events.  
Prerequisites: Graduate standing.  
Lecture + Lab + Other: 3 + 0 + 0

GEOS F631  Foundations of Geophysics  
4 Credits  
Offered Fall  
Applications of continuum mechanics, heat flow theory, and potential theory to geophysical, geologic and glaciological problems. Topics such as postglacial rebound, non-Newtonian fluid flow, thermal convection, stress-relaxation, rheology of earth materials, gravity, and magnetics will be discussed. Emphasis will be placed on methods and tools for solving a variety of problems in global and regional geophysics and the geophysical interpretation of solutions.  
Prerequisites: Graduate standing.  
Recommended: GEOS F419; MATH F302; MATH F314.  
Stacked with GEOS F431.  
Lecture + Lab + Other: 3 + 3 + 0

GEOS F633  Aquatic and Environmental Geochemistry  
3 Credits  
Offered Spring Odd-numbered Years  
Chemistry of aquatic and terrestrial environments, including thermodynamic, kinetic and structural principles applied to aqueous geochemical systems. Emphasis on aqueous speciation and heterogeneous interactions (e.g., dissolution/precipitation and sorption) involved in the partitioning, transformation and transport of chemical species in the environment.  
Prerequisites: CHEM F331 or Graduate standing.  
Cross-listed with CHEM F609.  
Lecture + Lab + Other: 3 + 0 + 0

GEOS F635  Advanced Economic Geology  
1-4 Credits  
Offered As Demand Warrants  
An advanced course providing an in-depth treatment of various aspects of economic geology. Specific topics will be considered in different semesters. They include ore microscopy, industrial minerals, economics of minerals, geochemistry of ore deposits, modern fossil fuel exploration and detailed study of particular ore deposit type. Each time the course is offered, only one topic will be presented.  
Prerequisites: Graduate standing.  
Special Notes: May be repeated for credit.  
Lecture + Lab + Other: 1-4 + 3 + 0

GEOS F635D  Geochemistry of Ore Deposits  
1-4 Credits  
Offered As Demand Warrants  
Lecture + Lab + Other: 1-4 + 3 + 0

GEOS F635F  Adv Econ Geology:Ore Deposits  
1-4 Credits  
Offered As Demand Warrants  
Lecture + Lab + Other: 1-4 + 3 + 0

GEOS F636  Beyond the Mouse: Computer Programming and Automation for Geoscientists  
2 Credits  
Offered Fall  
Basic concepts of computer programming and effective automation of tasks using a computer, with an emphasis on tools and problems common to the geosciences and other physical sciences. Use of MATLAB, shell scripting and various command line tools for data analysis, making scientific figures, maps and visualizations.  
Prerequisites: Graduate standing.  
Stacked with GEOS F436.  
Lecture + Lab + Other: 1 + 3 + 0

GEOS F637  Rock-Forming Minerals  
4 Credits  
Offered As Demand Warrants  
Examination of the rock-forming minerals; their structure and composition. Application of mineral data to problems in geochemistry, petrology and ore deposits. Laboratory involves analysis of minerals by various analytical techniques.  
Prerequisites: GEOS F417 and permission of instructor; or graduate standing.  
Lecture + Lab + Other: 3 + 3 + 0

GEOS F638  Basin Analysis  
3 Credits  
Offered As Demand Warrants  
Examines sedimentary basins as a record of subsidence. Review and discuss techniques used to image basin stratigraphy as well as the quantitative techniques which can be used to recover basin history.  
Prerequisites: Graduate standing.  
Stacked with GEOS F438.  
Lecture + Lab + Other: 3 + 0 + 0
GEOS F639  InSar and Its Applications
3 Credits
Offered As Demand Warrants
Introduction to the concepts of repeat-pass spaceborne SAR interferometry. Practical use of the technique to derive displacements of the solid earth, glaciers and ice sheets to a precision of a few centimeters and accurate digital elevation models of the Earth's surface.
Prerequisites: Basic remote sensing course.
Cross-listed with PHYS F639.
Lecture + Lab + Other: 2 + 2 + 0

GEOS F640  Petrology of Carbonate Rocks
4 Credits
Offered Spring Odd-numbered Years
Origin, depositional environments, diagenesis and classification of limestones, dolostones and related rocks.
Prerequisites: Graduate standing.
Lecture + Lab + Other: 3 + 3 + 0

GEOS F643  Sandstone Depositional Environments
3 Credits
Offered As Demand Warrants
Sedimentary depositional environments treating the hydrodynamics, sediment dispersal patterns and preservation potential of modern terrigenous clastic depositional environments and criteria for recognizing their ancient counterparts in the geologic record.
Prerequisites: GEOS F320 and GEOS F322; or graduate standing.
Lecture + Lab + Other: 3 + 0 + 0

GEOS F645  Petroleum Geology
3 Credits
Offered As Demand Warrants
Examines the origin of petroleum, the geologic controls of its distribution and accumulation and the basic tools used in exploration and exploitation, including subsurface mapping, well logging and exploration geophysics.
Prerequisites: Graduate standing.
Cross-listed with PETE F645.
Stacked with GEOS F445.
Lecture + Lab + Other: 3 + 0 + 0

GEOS F647  Advanced Sedimentology and Stratigraphy
3 Credits
Offered Spring Even-numbered Years
Various topics in sedimentology and stratigraphy. Specific offerings to be presented at various times include sequence stratigraphy and sea-level analysis, paleoclimatic and paleoceanographic analyses, sandstone petrology, thermal maturation and geohistory analysis of sediments.
Prerequisites: Graduate standing.
Lecture + Lab + Other: 3 + 0 + 0

GEOS F651  Quaternary Seminar
3 Credits
Offered As Demand Warrants
Discussion of the Quaternary Period (relatively recent past – spanning the past two million years) in order to gain a better understanding of the landscape, biota and climate of the present day. Quaternary studies are concerned with the historical dimension of the natural sciences. This seminar will range widely over diverse interdisciplinary subjects of Quaternary interest, such as paleoclimatology, paleobiogeography, vertebrate paleontology and sedimentology.
Prerequisites: Graduate standing.
Cross-listed with ANTH F651.
Stacked with ANTH F451; GEOS F452.
Lecture + Lab + Other: 3 + 0 + 0

GEOS F653  Palynology and Paleopalynology
4 Credits
Offered Fall Even-numbered Years
Survey of the evolutionary record of palynomorphs and their uses in biostratigraphy and paleoclimatology. Focus on evolution of palynomorphs from Precambrian to the present and concurrent evolutionary developments of producing plants. Use of Quaternary palynomorphs in reconstructing global climates. Labs involve collection of herbarium specimens, processing of fossil palynomorphs, study of type slides and a survey of palynomorphs from each geologic period.
Prerequisites: Graduate standing.
Stacked with GEOS F453.
Lecture + Lab + Other: 3 + 3 + 0

GEOS F654  Visible and Infrared Remote Sensing
3 Credits
Offered Spring Even-numbered Years
In-depth coverage of the principles, physics, sensor technology, processing and applications of remote sensing in the visible and infrared region, including but not limited to electromagnetic spectrum, radiation laws, spectral signatures, atmospheric interactions, temperature emissivity estimation, analysis and feature extraction from data sets. The laboratory part of the course will provide hands-on experience on special processing techniques, and the possibility of using these techniques for a student-defined term project in areas of geology, volcanology, glaciology, hydrology, environmental sciences, etc.
Prerequisites: GEOS F422.
Lecture + Lab + Other: 3 + 0 + 0

GEOS F655  Tectonic Geodesy
3 Credits
Offered Spring Even-numbered Years
Introduction to modern space geodetic methods and details their application to the study of active earth processes such as plate tectonics, fault mechanics and volcanology. Includes space geodesy methods such as global positioning system, as standard geophysical tools for the study of earthquakes, active tectonics and volcanology.
Prerequisites: MATH F314; MATH F410; MATH F432; graduate standing.
Lecture + Lab + Other: 3 + 0 + 0

GEOS F656  Paleopedology
3 Credits
Offered As Demand Warrants
A survey course focusing on the recognition and use of paleosols (fossil soils) as paleoenvironmental indicators, stratigraphic markers and in paleogeographic reconstructions from Precambrian to Holocene. Examination of theories of soil formation, major soil processes and approaches to soil classification. Review of geochemical, mineralogical, morphological and micromorphological techniques. Use of paleosols for paleolandcape evolution and basin analysis. Geological, tectonic, archaeological and environmental applications of paleosols are discussed.
Prerequisites: Graduate standing.
Stacked with GEOS F456.
Lecture + Lab + Other: 3 + 0 + 0
GEOS F657  Microwave Remote Sensing  
3 Credits  
Offered Spring Odd-numbered Years  
The principles and applications of active and passive microwave remote sensing with emphasis on spaceborne remote sensing of the Earth's atmosphere, land and oceans. The laboratory section will provide hands-on experience on special processing techniques, and the possibility of using these techniques for a student-defined term project in areas of geology, volcanology, glaciology, hydrology, environmental sciences, etc.  
Prerequisites: GEOS F422.  
Lecture + Lab + Other: 2 + 2 + 0  

GEOS F658  Applications of GPS and GIS in Geophysics  
3 Credits  
Offered As Demand Warrants  
Prerequisites: Graduate standing.  
Stacked with GEOS F458; GEOG F458.  
Lecture + Lab + Other: 2 + 3 + 0  

GEOS F660  The Dynamic Alaska Coastline  
3 Credits  
Offered Spring Even-numbered Years  
Alaska's diverse coastal system provides abundant ecosystem services and globally important resources. This course provides an interdisciplinary perspective on the dynamic coastal landscape of Alaska from Southcentral to the Arctic, and delves into the driving geological, oceanographic and climate processes shaping Alaska's past and present coastline. Through a semester long research projects students will learn how to measure and map coastal changes associated with natural and human perturbations. An overnight field trip will serve as an active learning opportunity to integrate course knowledge with hands-on field work.  
Prerequisites: Graduate standing.  
Cross-listed with GEOG F660.  
Stacked with GEOG F460; GEOS F460.  
Lecture + Lab + Other: 3 + 3 + 0  

GEOS F663  Glacial and Periglacial Geology  
4 Credits  
Offered As Demand Warrants  
Prerequisites: GEOS F304 or graduate standing.  
Stacked with GEOS F463.  
Lecture + Lab + Other: 3 + 3 + 0  

GEOS F666  Scientific Teaching  
2 Credits  
Offered Spring Even-numbered Years  
This course explores methods for teaching science at the university level. Emphasis is placed on methods of course design, instructional techniques, assessment and course management that have been shown by research to improve student learning. This course is intended for graduate students in the sciences who have an interest in improving their teaching skills. The course format will be a mixture of discussion, workshops and seminars. If the course is over-enrolled, priority will be given to teaching assistants who are assigned to teach large, introductory level (100 or 200 level) courses during the semester they are taking this course.  
Prerequisites: Graduate standing.  
Lecture + Lab + Other: 2 + 0 + 0  

GEOS F670  Selected Topics in Volcanology  
2 Credits  
Offered Fall  
Survey course in subjects relating to volcanology. Possible subjects include, but are not limited to, eruption dynamics, geophysics of eruptions, volatiles in volcanic systems, modeling volcanic systems. May be repeated for credit.  
Prerequisites: Graduate standing.  
Lecture + Lab + Other: 2 + 0 + 0  

GEOS F671  Volcano Seismology  
3 Credits  
Offered Spring Odd-numbered Years  
Survey of seismic behavior of volcanoes. Topics include instrumentation, terminology, swarms and their attributes, high-frequency events, volcanic explosions, volcanic tremor, attenuation and velocity structure, cycles of activity, eruption forecasting, detection of magma chambers, case studies and selected topics. Oral and written student presentations will be required.  
Prerequisites: Graduate standing.  
Lecture + Lab + Other: 3 + 0 + 0  

GEOS F675  Presentation Techniques in the Geosciences  
2 Credits  
Offered As Demand Warrants  
Instruction and practice in oral and written communication skills specifically related to the geosciences. Oral and written presentation of abstracts, resumes, proposals and reports required. Works critically analyzed by instructor(s) and peers for both geoscience content and communication effectiveness.  
Prerequisites: Graduate standing.  
Lecture + Lab + Other: 1 + 3 + 0  

GEOS F676  Remote Sensing of Volcanic Eruptions  
3 Credits  
Offered As Demand Warrants  
Focuses on the use of satellite images to detect, monitor and mitigate volcanic hazards, and to understand eruption processes. Thermal anomalies, volcanic clouds and surface morphological features will be discussed in the lecture and test cases analyzed in the laboratory. Satellite data include GOES, AVHRR, MODIS, ASTER, Landsat and SAR. Course may be repeated twice for credit.  
Recommended: GEOS F422 or equivalent remote sensing class.  
Lecture + Lab + Other: 2 + 3 + 0
GEOS F680  Climate Change Processes: Past, Present, Future  (a)  
4 Credits  
Offered Fall Odd-numbered Years  
This 'synthesis' course for Geography, NRM, or Natural Sciences undergraduates provides literacy in the rapidly developing field of climate-change science. Students will gain an understanding of climate dynamics and Earth's climate history and will be trained to critically evaluate the validity of paleoclimatic reconstructions and climate-model predictions.  
Prerequisites: Junior or senior standing in major; ATM F401, GEOS F315, MSL F419 or MSL F481.  
Cross-listed with ATM F680.  
Stacked with ATM F480, GEOG F480, GEOS F480.  
Lecture + Lab + Other: 4 + 0 + 0

GEOS F682  Geoscience Seminar  
1 Credit  
Offered Fall and Spring  
A weekly seminar, given by guest speakers, on a topic in geosciences. Students are expected to prepare for the seminars and to participate in discussion following the seminars.  
Prerequisites: Graduate standing.  
Stacked with GEOS F482.  
Lecture + Lab + Other: 1 + 0 + 0

GEOS F686  Vertebrate Paleontology  
3 Credits  
Offered Spring Odd-numbered Years  
The study of vertebrate evolution through geologic time. Covers the temporal range, diversity and systematics of major vertebrate groups as documented in the fossil record, with an emphasis on current problems in vertebrate evolutionary pattern and process. Labs emphasize comparative morphology and identification of major vertebrate groups.  
Prerequisites: Graduate standing.  
Cross-listed with BIOL F686.  
Stacked with BIOL F486; GEOS F486.  
Lecture + Lab + Other: 2 + 3 + 0

GEOS F692  Geol/Geophys Seminar  
1-6 Credits  
Lecture + Lab + Other: 0 + 0 + 0

GEOS F692A  Geology/Geophysics Seminar  
1-6 Credits  
Lecture + Lab + Other: 1-6 + 0 + 0

GEOS F692B  Geology/Geophysics Seminar  
1-6 Credits  
Lecture + Lab + Other: 1-6 + 0 + 0

GEOS F692P  Seminar  
1-6 Credits  
Lecture + Lab + Other: 0 + 0 + 0

GEOS F698  Non-thesis Research/Project  
1-9 Credits  
Lecture + Lab + Other: 0 + 0 + 0

GEOS F699  Thesis  
1-12 Credits  
Lecture + Lab + Other: 0 + 0 + 0