GEOSCIENCES (GEOS)

College of Natural Science & Mathematics
Department of Geosciences
907-474-7565

GEOS F101L  GEOS F101X Laboratory
0 Credit
Offered Fall
Co-requisites: GEOS F101X.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Non-Graded

GEOS F101X  The Dynamic Earth  (n)
4 Credits
Offered Fall
An introduction to how the Earth works and the geophysical and geochemical basis for our understanding of the Earth, emphasizing Alaskan examples. A course theme is that the Earth is changing around us, at a variety of scales. Students collect, analyze and interpret data in all laboratory exercises.
Prerequisites: Placement in WRTG F111X; placement in MATH F105.
Co-requisites: GEOS F101L.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F106X  Life in the Age of Dinosaurs  (n)
4 Credits
Offered Spring
Promote a broader understanding of deep time through an examination of life and environments during the Mesozoic, or "Age of Dinosaurs." Discussions and exercises will focus on major events and processes that shaped the physical environments of the Mesozoic, such as the formation and break up of continents, global climate, and changing sea levels. Building on this foundation, the course will examine the fossil record to learn what it reveals about the major patterns in the diversity of terrestrial and marine life. Special emphasis will be placed on the origin, extinction, and paleobiology of dinosaurs. Important groups of contemporary vertebrates and invertebrates, including marine reptiles, mammals, flying reptiles, and ammonites will also be examined. The rise of flowering plants and the importance of fossil floras in understanding Mesozoic climates will be explored. Labs will provide opportunities to examine and identify fossils and use them to reconstruct ancient environments.
Prerequisites: Placement in WRTG F111X; placement in MATH F105.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F111X  Earth and Environment: Elements of Physical Geography  (n)
4 Credits
Offered Fall
This asynchronous online course focuses on the processes that shape the physical environment, especially in relation to Alaska. Climate change will serve as the capstone topic, which integrates course concepts with current challenges facing society. Labs will build research and skillsets through field and computer-based activities. Special fees will apply.
Prerequisites: Placement in WRTG F111X; placement in MATH F105.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F112L  GEOS F112X Laboratory  (n)
0 Credit
Offered Spring
Co-requisites: GEOS F112X.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Non-Graded

GEOS F112X  The History of Earth and Life  (n)
4 Credits
Offered Spring
Historical geologic interpretation, geologic time scale, stratigraphic record and interpretation. Sedimentation and plate tectonics, fossil record and utilization, biostratigraphy, and geologic evolution of the North American continent. Lab examination of fossils, interpretation of geologic maps and stratigraphic columns.
Prerequisites: GEOS F101X; placement in WRTG F111X; placement in MATH F105.
Co-requisites: GEOS F112L.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F119  Glaciers, Earthquakes and Volcanoes: Past, Present and Future
3 Credits
Offered Spring
This course provides a basic overview of the science and societal relevance of earthquakes, glaciers and volcanoes, with an emphasis on Alaska.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F120L  GEOS F120X Laboratory
0 Credit
Offered Spring
Co-requisites: GEOS F120X.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Non-Graded
GEOS F120X  Glaciers, Earthquakes and Volcanoes: Past, Present and Future  
Offered Spring
This course provides a basic overview of the science and societal relevance of earthquakes, glaciers and volcanoes, with an emphasis on Alaska.
Co-requisites: GEOS F120L.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F190  The Geology of Wine
Offered Spring Even-numbered Years
This course explores the relationship between geology, climate, and viticulture. Aspects of geology that influence landscape, soil development and climate are evaluated in reference to their effects on wine-growing regions. The geology, tectonic setting, soil and climate of individual wine-growing areas will be explored through lectures, discussions, class projects/presentations, and lab wine tastings.
Prerequisites: Student must be 21 years of age to enroll.
Lecture + Lab + Other: 1.5 + 0.5 + 0
Grading System: Pass/Fail Grades

GEOS F192  Seminar
Offered Fall
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken unlimited times for up to 99 credits

GEOS F213  Mineralogy  
Offered Fall
Mineral chemistry, atomic structure, elementary crystallography, optical crystallography and descriptive and determinative mineralogy. Instrumental determinative techniques (x-ray diffraction, petrographic microscope).
Prerequisites: MATH F151X, MATH F230X, MATH F251X, MATH F252X or MATH F253X (may be taken concurrently); CHEM F105X; GE F261 or GEOS F101X.
Lecture + Lab + Other: 2 + 6 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F214  Petrology and Petrography  
Offered Spring
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
Grading System: Letter Grades with option of Plus/Minus

GEOS F221  Introduction to Field Geology
Offered Spring Even-numbered Years
This course gives students the opportunity to apply 100-level geologic concepts at field sites with excellent exposures and straightforward stratigraphy. Participants use tools and technology, including a Jacob staff, geologic compass, GPS receivers and mapping apps, to measure stratigraphic sections and create a geologic map on a topographic base map.
Prerequisites: GEOS F101X; GEOS F112X.
Lecture + Lab + Other: 8 + 33 + 24
Grading System: Letter Grades with option of Plus/Minus

GEOS F225  Field and Computer Methods in Geology  
Offered Spring
We discuss and practice basic geologic field methods, including taking notes, topographic maps, measurement of structural elements, field mapping, and field safety, both with traditional analogue and modern digital tools. Computers are used for collecting data in the field, processing field and analytical data and producing maps and reports.
Prerequisites: GEOS F214 (may be taken concurrently).
Lecture + Lab + Other: 1 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F258  Unmanned Aircraft Systems (UAS) Operations
Offered As Demand Warrants
Covers the use of unmanned aircraft systems (UAS), sensors, and support infrastructure required to conduct a selected mission set. Emphasis is on mission analysis, planning, and conduct, including definition of requirements/constraints, identification of appropriate assets, flight planning considerations, and data analysis requirements. Teams coordinate resources for mission and report results.
Cross-listed with AERO F258; CS F258; and ME F258.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F262  Rocks and Minerals
Offered Fall Even-numbered Years
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
Grading System: Letter Grades with option of Plus/Minus

GEOS F292  Seminar
Offered Fall
Lecture + Lab + Other: 1-6 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken unlimited times for up to 99 credits

GEOS F292P  Seminar
Lecture + Lab + Other: 1-6 + 0 + 0
Grading System: Pass/Fail Grades
Repeatable for Credit: May be taken unlimited times for up to 99 credits
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Offered</th>
<th>Corequisites</th>
<th>Prerequisites</th>
<th>Lecture + Lab + Other</th>
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<tr>
<td>GEOS F304</td>
<td>Geomorphology</td>
<td>3</td>
<td>Offered Spring Odd-numbered Years</td>
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<td>GEOS F309</td>
<td>Tectonics</td>
<td>3</td>
<td>Offered Fall Odd-numbered Years</td>
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<td>GEOS F314</td>
<td>Structural Geology</td>
<td>(n)</td>
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<td>3 + 0 + 0</td>
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<td>GEOS F315</td>
<td>Paleobiology and Paleontology</td>
<td>(n)</td>
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<td>GEOS F317</td>
<td>Paleontological Research and Laboratory Methods</td>
<td>2</td>
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<td>1 + 3 + 0</td>
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<td>GEOS F320</td>
<td>Sedimentology for Geological Engineers</td>
<td>3</td>
<td>Offered Fall</td>
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<td>Origin, classification, composition, transportation, deposition and diageneis of sediments. Emphasis on sedimentary processes, sedimentary petrology and interpretation of ancient sedimentary rocks. Not intended for Geoscience majors and does not substitute for GEOS F322.</td>
<td>3 + 0 + 0</td>
<td>Letter Grades with option of Plus/Minus</td>
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<td>GEOS F322</td>
<td>Stratigraphy and Sedimentation</td>
<td>(n)</td>
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<td>3 + 0 + 0</td>
<td>Letter Grades with option of Plus/Minus</td>
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<td>GEOS F332</td>
<td>Ore Deposits and Structure</td>
<td>3</td>
<td>Offered Spring Even-numbered Years</td>
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<td>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.</td>
<td>3 + 3 + 0</td>
<td>Letter Grades with option of Plus/Minus</td>
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<td>GEOS F370</td>
<td>Sedimentology for Geological Engineers</td>
<td>(n)</td>
<td></td>
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<td>Origin, classification, composition, transportation, deposition and diageneis of sediments. Emphasis on sedimentary processes, sedimentary petrology and interpretation of ancient sedimentary rocks. Not intended for Geoscience majors and does not substitute for GEOS F322.</td>
<td>3 + 0 + 0</td>
<td>Letter Grades with option of Plus/Minus</td>
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<td>GEOS F370</td>
<td>Sedimentology and Structural Geology for Petroleum Engineers</td>
<td>(n)</td>
<td>Offered Fall</td>
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<td>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.</td>
<td>3 + 3 + 0</td>
<td>Letter Grades with option of Plus/Minus</td>
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Grading System:
- Letter Grades with option of Plus/Minus

Cross-listed with PETE F370.
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: COM F131X or COM F141X; GEOS F225; junior standing.
Lecture + Lab + Other: 0.5 + 0 + 1.5
Grading System: Letter Grades with option of Plus/Minus

GEOS F380  Geological Hazards
3 Credits
Offered Spring
Surveys natural hazards and the disasters they cause, with emphasis on geological hazards in Alaska. Investigates hazardous phenomena, prediction and mitigation. Topics include: earthquakes, volcanoes, tsunamis, weather/climate and asteroid impacts. Provides 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
Grading System: Letter Grades with option of Plus/Minus

GEOS F392  Seminar
1-6 Credits
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken unlimited times for up to 99 credits

GEOS F392P  Seminar
1-6 Credits
Lecture + Lab + Other: 1-6 + 6 + 0
Grading System: Pass/Fail Grades
Repeatable for Credit: May be taken 98 times for up to 99 credits

GEOS F398  Research
1-6 Credits
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken unlimited times for up to 99 credits

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 F123X or PHYS F211X.
Stacked with GEOS F606.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F413  Geology of Alaska
2 Credits
Offered Fall Odd-numbered Years
An overview of the geological provinces of Alaska, followed by in-depth exploration of the geologic history and tectonic evolution of those regions.
Prerequisites: GEOS F309 and GEOS F314.
Stacked with GEOS F612.
Lecture + Lab + Other: 2 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken 2 times for up to 4 credits

GEOS F416  Applied Geophysics
(n)
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
Grading System: Letter Grades with option of Plus/Minus

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
Grading System: Letter Grades with option of Plus/Minus

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
Grading System: Letter Grades with option of Plus/Minus

GEOS F422  Geoscience Applications of Remote Sensing
(n)
3 Credits
Offered Spring Odd-numbered Years
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.
Prerequisites: PHYS F124X or PHYS F212X.
Lecture + Lab + Other: 2 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus
GEOS F424  International Volcanological Field School  
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: application required, permission of instructor, appropriate background in Geology, Chemistry and Physics.  
Stacked with GEOS F624.  
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  
Grading System: Letter Grades with option of Plus/Minus  
Repeatable for Credit: May be taken 2 times for up to 6 credits  

GEOS F426  Applied Seismology  
4 Credits  
Offered Spring Odd-numbered Years  
Presentation of modeling techniques for analyzing earthquakes and Earth structure using wave propagation algorithms and real seismic data. Topics include the seismic wavefield (body waves and surface waves), earthquake moment tensors, earthquake location, and seismic tomography.  
Prerequisites: MATH F253X; MATH F314.  
Stacked with GEOS F626.  
Lecture + Lab + Other: 3 + 3 + 0  
Grading System: Letter Grades with option of Plus/Minus  

GEOS F427  Inverse Problems and Parameter Estimation  
3 Credits  
Offered Spring Even-numbered Years  
An inverse problem uses observations to infer properties of an unknown physical model. This course covers methods for solving inverse problems, including numerous examples arising in the natural sciences. Topics include linear regression, method of least squares, estimation of uncertainties, iterative optimization, and probabilistic (Bayesian) and sampling approaches.  
Prerequisites: MATH F253X; MATH F314.  
Cross-listed with PHYS F625.  
Stacked with GEOS F627.  
Lecture + Lab + Other: 2 + 3 + 0  
Grading System: Letter Grades with option of Plus/Minus  

GEOS F428  Elementary Scanning Electron Microscopy  
1 Credit  
Offered Spring Even-numbered Years  
Basic theory and operating procedures for scanning electron microscopy. Includes sample preparation, imaging and qualitative elemental analysis. Biological and nonbiological applications are covered.  
Prerequisites: Junior standing.  
Stacked with GEOS F628.  
Lecture + Lab + Other: 0.5 + 1.5 + 0  
Grading System: Pass/Fail Grades  

GEOS F430  Statistics and Data Analysis in Geology  
(n)  
3 Credits  
Offered Spring  
Computer-supported geologic applications of elementary statistics, Markov chains, time-series analysis, trend-surface analysis, factor analysis, cluster analysis, discriminant analysis, and multiple regression.  
Prerequisites: GEOS F225; STAT F200X.  
Lecture + Lab + Other: 3 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus  

GEOS F431  Foundations of Geophysics  
4 Credits  
Offered Fall Even-numbered Years  
Applications of continuum mechanics, heat flow, and potential theory to geophysical 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 is on methods to solve problems in global and regional geophysics and the interpretation of solutions.  
Prerequisites: GEOS F419; MATH F302; MATH F314.  
Stacked with GEOS F631.  
Lecture + Lab + Other: 3 + 3 + 0  
Grading System: Letter Grades with option of Plus/Minus  

GEOS F436  Programming and Automation for Geoscientists  
2 Credits  
Offered Fall  
Basic concepts of computer programming and effective task automation for computers, with an emphasis on tools and problems common to the geosciences and other physical sciences. Use of Python, Jupyter Notebooks, shell scripting and command line tools, making scientific figures, maps and visualizations. Provided asynchronously remotely.  
Prerequisites: GEOS F630; GEOS F636.  
Lecture + Lab + Other: 1 + 3 + 0  
Grading System: Pass/Fail Grades  

GEOS F438  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: GEOS F322 or GEOS F370.  
Recommended: GEOS F314; GEOS F419.  
Stacked with GEOS F638.  
Lecture + Lab + Other: 3 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus  

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.  
Prerequisites: GEOS F304; GEOS F315; GEOS F322.  
Cross-listed with ANTH F451.  
Stacked with GEOS F651; ANTH F651.  
Special Notes: Topics range widely over diverse interdisciplinary subjects of quaternary interest, such as paleoclimatology, paleobiogeography, vertebrate paleontology and sedimentology.  
Lecture + Lab + Other: 3 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus
GEOS F453  Palynology and Paleopalynology  (n)  
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.  
Lecture + Lab + Other: 3 + 3 + 0  
Grading System: Letter Grades with option of Plus/Minus  

GEOS F454  Field Geology  (n)  
6 Credits  
Offered Summer Odd-numbered Years  
Mapping sedimentary and crystalline rocks in different tectonic settings in 
central Alaska using analog and digital tools. Collecting structural and 
lithological data, compiling geologic maps, and drafting written reports. Mapping challenges increase from intensive guidance by "geo 
buddies" during the initial project to independent mapping during the final 
capstone project.  
Prerequisites: WRTG F111X; WRTG F211X, WRTG F212X, WRTG F213X, 
WRTG F214X; GEOS F214; GEOS F225; GEOS F309; GEOS F314; 
GEOS F315; GEOS F322; junior standing.  
Lecture + Lab + Other: 6 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus  

GEOS F456  Paleopedology  
3 Credits  
Offered As Demand Warrants  
Origin, classification, composition, transportation, deposition and 
diagenesis of sediments. Emphasis on sedimentary processes, 
sedimentary petrology and interpretation of ancient sedimentary rocks. 
Not intended for Geoscience majors and does not substitute for Geos 
322.  
Prerequisites: GEOS F322 or NRM F380.  
Stacked with GEOS F656.  
Lecture + Lab + Other: 3 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus  

GEOS F458  Big Geospatial Data  (n)  
3 Credits  
Offered Fall Odd-numbered Years  
Analysis of large geospatial data sets and data-driven modeling for 
solving geoscientific problems. The class intertwines i) cloud-based 
processing of big vector and raster data sets from GPS surveys, models 
and remote sensing, and ii) predictive modeling using data science 
techniques such as Random Forests.  
Prerequisites: GEOS F422, NRM F338 or senior standing in science or 
engineering.  
Stacked with GEOS F658.  
Lecture + Lab + Other: 2 + 3 + 0  
Grading System: Letter Grades with option of Plus/Minus  

GEOS F459  Visible and Infrared Remote Sensing  
3 Credits  
Offered Spring Even-numbered Years  
The course covers the principles and practice of remote sensing in the 
visible and infrared region, including spectral signatures, radiative 
transfer, image analysis, and information extraction. The laboratory part 
provides hands-on experience with multispectral, thermal, hyperspectral, 
and LiDAR data sets. Practical examples are drawn from geology, 
hydrology, and forestry.  
Prerequisites: GEOS F422.  
Stacked with GEOS F659.  
Lecture + Lab + Other: 2 + 3 + 0  
Grading System: Letter Grades with option of Plus/Minus  

GEOS F460  The Dynamic Alaska Coastline  
3 Credits  
Offered Spring Even-numbered Years  
This course will provide the knowledge base for understanding Alaska's 
dynamic coastlines with an emphasis on climate and tectonic, driven 
changes. The class includes a multiday field trip to Homer offering field- 
based learning activities. Special fees apply.  
Prerequisites: Junior standing; GEOS F111X or GEOS F101X; 
CHEM F105X or PHYS F123X; NRM F338 or equivalent GIS coursework.  
Stacked with GEOS F660.  
Lecture + Lab + Other: 3 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus  

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  
Grading System: Letter Grades with option of Plus/Minus  

GEOS F469  Geodetic Methods and Modeling  
3 Credits  
Offered Fall Odd-numbered Years  
Theory and application of modern geodetic tools to measure Earth's 
surface deformation with emphasis on GPS and InSAR. Basics of 
data processing. Evaluation of signals and modeling of their sources. Applications include magma systems, earthquake cycle, and hydro- and 
cryosphere. Labs in Python require programming experience (GEOS F636/ 
F436).  
Prerequisites: MATH F410; MATH F314; MATH F432.  
Stacked with GEOS F669.  
Lecture + Lab + Other: 2 + 3 + 0  
Grading System: Letter Grades with option of Plus/Minus  

GEOS F477  Ice in the Climate System  (n)  
3 Credits  
Offered As Demand Warrants  
Earth's cryosphere includes seasonal snow, permafrost, sea ice, 
mountain glaciers and ice sheets. This course will cover the formation 
of each of these forms of snow and ice and their response to changing 
environmental conditions. Interdisciplinary perspectives allow study of 
the role snow and ice plays within the Arctic system.  
Prerequisites: PHYS F123X or PHYS F211X; MATH F251X.  
Lecture + Lab + Other: 2 + 3 + 0  
Grading System: Letter Grades with option of Plus/Minus
GEOS F480  Climate Change Processes: Past, Present, Future
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.
Cross-listed with ATM F480.
Stacked with ATM F680 and GEOS F680.
Grading System: Letter Grades with option of Plus/Minus

GEOS F481  Snow in the Environment
3 Credits
Offered As Demand Warrants
Snow is a critical buffer between cold air temperatures and warming permafrost, between harsh winds and vegetation, and between herbivores and their food source. This course focuses on snow properties, metamorphism and redistribution by wind. We will examine the snow interactions with permafrost, glaciers, sea ice, vegetation, wildlife and humans.
Stacked with GEOS F681.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F482  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.
Stacked with GEOS F682.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Pass/Fail Grades
Repeatable for Credit: May be taken 99 times for up to 99 credits

GEOS F483  Research Design, Writing and Presentation Methods
3 Credits
Offered Fall
This is a capstone professional development class where students write a research proposal, participate in engagement activities, and produce professional documents that prepare students for graduate and professional careers. It is writing and oral intensive and will focus on the oral and written presentation of your work.
Prerequisites: COM F131X or COM F141X, WRTG F211X, WRTG F212X, WRTG F213X or WRTG F214X; junior standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F485  Mass Extinctions, Neocatastrophism and the History of Life
3 Credits
Offered Spring Odd-numbered Years
In-depth analysis of mass extinction, focusing on evidence for catastrophes and impact on the uniformitarian paradigm. Effects of mass extinctions on the evolution of extant fossil biota is explored through classic and current papers. The course emphasizes critical reading and application of scientific methods to reconstruct catastrophic deep-time events.
Prerequisites: GEOS F322 and GEOS F315.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F486  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: BIOL F310 or GEOS F315.
Cross-listed with BIOL F486.
Stacked with GEOS F686; BIOL F686.
Lecture + Lab + Other: 2 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F488  Undergraduate Research
1-3 Credits
Offered As Demand Warrants
Advanced research topics from outside the usual undergraduate requirements.
Prerequisites: Permission of instructor.
Recommended: A substantial level of technical/scientific background.
Lecture + Lab + Other: 1-3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken 8 times for up to 24 credits

GEOS F488P  Undergraduate Research
1-3 Credits
Offered As Demand Warrants
Advanced research topics from outside the usual undergraduate requirements.
Prerequisites: Permission of instructor.
Recommended: A substantial level of technical/scientific background.
Lecture + Lab + Other: 1-3 + 0 + 0
Grading System: Pass/Fail Grades
Repeatable for Credit: May be taken 8 times for up to 24 credits

GEOS F492  Seminar
1-6 Credits
This course is intended for talented students to explore geology or geophysics more deeply through research under the mentorship of a faculty member in the department.
Prerequisites: A substantial level of technical/scientific background.
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken unlimited times for up to 99 credits

GEOS F492P  Seminar
1-6 Credits
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Pass/Fail Grades
Repeatable for Credit: May be taken 98 times for up to unlimited credits

GEOS F499  Geology and Geophysics Senior Thesis
3 Credits
This course is intended for talented students to explore geology or geophysics more deeply through research under the mentorship of a faculty member in the department.
Prerequisites: Geology and Geophysics major with senior standing and a GPA of 3.2 or higher, completion of a minimum of 2 credits of GEOS F488 on a project approved by faculty mentor and department chair, and submission of a proposal approved by faculty mentor and department chair.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
GEOS F602  Geophysical Fields  
3 Credits  
Offered Spring Odd-numbered Years  
Introduction to the application of potential theory and its associated mathematical tools to fields of geophysical interest, namely gravity, magnetics, and heat flow. 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: MATH F410 and MATH F432; or graduate standing.  
Lecture + Lab + Other: 3 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus  

GEOS F604  Seismology  
3 Credits  
Offered Spring Odd-numbered Years  
Sources of ground motion including focal mechanisms, magnitude and propagation of waves within the earth. Measurement of seismic data by analog and digital techniques and subsequent treatment of seismic data by various techniques including inversion.  
Lecture + Lab + Other: 3 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus

GEOS F605  Geochronology  
3 Credits  
Offered Fall Odd-numbered Years  
Application of the most commonly used radiometric dating methods to geologic problems. Fundamentals of the K-Ar, Rb-Sr, fission-track, U-Th-Pb and C methods. Laboratory training in K-Ar and fission-track dating techniques.  
Prerequisites: Graduate standing.  
Lecture + Lab + Other: 3 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus

GEOS F606  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: Graduate standing.  
Lecture + Lab + Other: 3 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus

GEOS F611  Advanced Structural Geology and Tectonics  
3 Credits  
Offered As Demand Warrants  
This advanced course in structural geology and tectonics offers in-depth treatment of topics that may vary with each offering. Examples are tectonics and sedimentation, mountain belts of the world, structural analysis, structural geology of specific tectonic settings, active tectonics and topography, structural interpretation of seismic reflection data, and other topics.  
Prerequisites: GEOS F314; graduate standing.  
Special Notes: Course may be repeated for different topics up to three times for credit.  
Lecture + Lab + Other: 3 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus
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
Grading System: Letter Grades with option of Plus/Minus

GEOS F621  Advanced Petrology
4 Credits
Offered As Demand Warrants
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
Grading System: Letter Grades with option of Plus/Minus

GEOS F621B  Adv Petrology: Igneous Petrology
3-4 Credits
Offered As Demand Warrants
Lecture + Lab + Other: 2-3 + 3-6 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F621C  Advanced Petrology
3-4 Credits
Offered As Demand Warrants
Lecture + Lab + Other: 2-3 + 3-6 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F622  Digital Image Processing in the Geosciences
3 Credits
Offered Fall Even-numbered Years
Image processing and analysis techniques to monitor and understand
the Earth system. Geoscience applications to be addressed include thin-
section analysis, remote sensing of geohazards and geomorphometry.
Apart from lectures and demonstrations, the advantages and drawbacks
of image processing techniques will be evaluated through exercises and a
course project.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F624  International Volcanological Field School
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
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken 2 times for up to 6 credits

GEOS F626  Applied Seismology
4 Credits
Offered Spring Odd-numbered Years
Presentation of modeling techniques for analyzing earthquakes and
Earth structure using wave propagation algorithms and real seismic
data. Topics include the seismic wavefield (body waves and surface
waves), earthquake moment tensors, earthquake location, and seismic
tomography.
Prerequisites: MATH F253X; MATH F314.
Stacked with GEOS F426.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F627  Inverse Problems and Parameter Estimation
3 Credits
Offered Spring Even-numbered Years
An inverse problem uses observations to infer properties of an unknown
physical model. This course covers methods for solving inverse
problems, including numerous examples arising in the natural sciences.
Topics include linear regression, method of least squares, estimation
of uncertainties, iterative optimization, and probabilistic (Bayesian) and
sampling approaches.
Prerequisites: MATH F253X; MATH F314.
Cross-listed with PHYS F625.
Stacked with GEOS F427.
Lecture + Lab + Other: 2 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F628  Elementary Scanning Electron Microscopy
1 Credit
Offered Spring Even-numbered Years
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
Grading System: Pass/Fail Grades
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
Grading System: Letter Grades with option of Plus/Minus

GEOS F631  Foundations of Geophysics
4 Credits
Offered Fall Even-numbered Years
Applications of continuum mechanics, heat flow, and potential theory
to geophysical 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 is
on methods to solve problems in global and regional geophysics and the
interpretation of solutions.
Prerequisites: Graduate standing.
Recommended: GEOS F419; MATH F302; MATH F314.
Stacked with GEOS F431.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

GEOS F633  Aqueous 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
Grading System: Letter Grades with option of Plus/Minus

GEOS F636  Programming and Automation for Geoscientists
2 Credits
Offered Fall
Basic concepts of computer programming and effective task automation
for computers, with an emphasis on tools and problems common to
the geosciences and other physical sciences. Use of Python, Jupyter
Notebooks, shell scripting and command line tools, making scientific
figures, maps and visualizations. Provided asynchronously remotely.
Prerequisites: Graduate standing.
Stacked with GEOS F436.
Lecture + Lab + Other: 1 + 3 + 0
Grading System: Pass/Fail Grades

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
Grading System: Letter Grades with option of Plus/Minus

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
Grading System: Letter Grades with option of Plus/Minus

GEOS F640  Petrology of Carbonate Rocks
4 Credits
Offered As Demand Warrants
Origin, depositional environments, diagenesis and classification of
limestones, dolostones and related rocks.
Prerequisites: Graduate standing.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

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
Grading System: Letter Grades with option of Plus/Minus

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
Grading System: Letter Grades with option of Plus/Minus

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
common with the historical dimension of the natural sciences.
Prerequisites: Graduate standing.
Cross-listed with ANTH F651.
Stacked with ANTH F451; GEOS F452.
Special Notes: Topics range widely over diverse interdisciplinary subjects
of quaternary interest, such as paleoclimatology, paleobiogeography,
vertebrate paleontology and sedimentology.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
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  
Grading System: Letter Grades with option of Plus/Minus 

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  
Grading System: Letter Grades with option of Plus/Minus 

GEOS F655  Paleopedology  
3 Credits  
Offered As Demand Warrants  
Prerequisites: Graduate standing.  
Stacked with GEOS F456.  
Lecture + Lab + Other: 3 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus 

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  
Grading System: Letter Grades with option of Plus/Minus 

GEOS F658  Big Geospatial Data  
3 Credits  
Offered Fall Odd-numbered Years  
Analysis of large geospatial data sets and data-driven modeling for solving geoscientific problems. The class intertwines i) cloud-based processing of big vector and raster data sets from GPS surveys, models and remote sensing, and ii) predictive modeling using data science techniques such as Random Forests.  
Prerequisites: Graduate standing in science or engineering.  
Stacked with GEOS F458.  
Lecture + Lab + Other: 2 + 3 + 0  
Grading System: Letter Grades with option of Plus/Minus 

GEOS F659  Visible and Infrared Remote Sensing  
3 Credits  
Offered Spring Even-numbered Years  
The course covers the principles and practice of remote sensing in the visible and infrared region, including spectral signatures, radiative transfer, image analysis, and information extraction. The laboratory part provides hands-on experience with multispectral, thermal, hyperspectral, and LiDAR data sets. Practical examples are drawn from geology, hydrology, and forestry.  
Stacked with GEOS F459.  
Lecture + Lab + Other: 2 + 3 + 0  
Grading System: Letter Grades with option of Plus/Minus 

GEOS F660  The Dynamic Alaska Coastline  
3 Credits  
Offered Spring Even-numbered Years  
This course will provide the knowledge base for understanding Alaska's dynamic coastlines with an emphasis on climate and tectonic, driven changes. The class includes a multiday field trip to Homer offering field-based learning activities. Special fees apply.  
Prerequisites: Graduate standing.  
Stacked with GEOS F460.  
Lecture + Lab + Other: 3 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus 

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  
Grading System: Letter Grades with option of Plus/Minus
GEOS F669  Geodetic Methods and Modeling  
3 Credits  
Offered Fall Odd-numbered Years  
Theory and application of modern geodetic tools to measure Earth's surface deformation with emphasis on GPS and InSAR. Basics of data processing. Evaluation of signals and modeling of their sources. Applications include magma systems, earthquake cycle, and hydro- and cryosphere. Labs in Python require programming experience (GEOS F636/F436).  
Prerequisites: MATH F314; GEOS F436 or GEOS F636; graduate standing.  
Stacked with GEOS F469.  
Lecture + Lab + Other: 2 + 3 + 0  
Grading System: Letter Grades with option of Plus/Minus  
Repeatable for Credit: May be taken 2 times for up to 6 credits

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, volcanology in volcanic systems, modeling volcanic systems. May be repeated for credit.  
Prerequisites: Graduate standing.  
Lecture + Lab + Other: 2 + 0 + 0  
Grading System: Pass/Fail Grades  
Repeatable for Credit: May be taken 3 times for up to 6 credits

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  
Grading System: Letter Grades with option of Plus/Minus

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.  
Prerequisites: Recommended: GEOS F422 or equivalent remote sensing class.  
Lecture + Lab + Other: 2 + 3 + 0  
Grading System: Letter Grades with option of Plus/Minus  
Repeatable for Credit: May be taken 2 times for up to 6 credits

GEOS F680  Climate Change Processes: Past, Present, Future  
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, OCN F419 or OCN F481.  
Cross-listed with ATM F680.  
Stacked with ATM F480, GEOS F480.  
Lecture + Lab + Other: 4 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus

GEOS F681  Snow in the Environment  
3 Credits  
Offered As Demand Warrants  
Snow is a critical buffer between cold air temperatures and warming permafrost, between harsh winds and vegetation, and between herbivores and their food source. This course focuses on snow properties, metamorphism and redistribution by wind. We will examine the snow interactions with permafrost, glaciers, sea ice, vegetation, wildlife and humans.  
Prerequisites: Graduate student standing.  
Stacked with GEOS F481.  
Lecture + Lab + Other: 3 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus

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  
Grading System: Pass/Fail Grades  
Repeatable for Credit: May be taken 99 times for up to 99 credits

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  
Grading System: Letter Grades with option of Plus/Minus

GEOS F692  Geol/Geophys Seminar  
1-6 Credits  
Lecture + Lab + Other: 0 + 0 + 0  
Grading System: Letter Grades with option of Plus/Minus  
Repeatable for Credit: May be taken unlimited times for up to 99 credits
GEOS F692P  Seminar
1-6 Credits
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Pass/Fail Grades
Repeatable for Credit: May be taken 98 times for up to unlimited credits

GEOS F698  Non-thesis Research/Project
1-9 Credits
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Pass/Fail Grades
Repeatable for Credit: May be taken unlimited times for up to 99 credits

GEOS F699  Thesis
1-12 Credits
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Pass/Fail Grades
Repeatable for Credit: May be taken unlimited times for up to 99 credits