

DEPARTMENT OF GEOLOGY

College of Arts and Sciences

Department of Geology
221 McGilvrey Hall
Kent Campus
330-672-2680
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www.kent.edu/geology

Undergraduate Programs

- Earth Science - B.A.
- Geology - B.A.
- Geology - B.S.

Minors

- Geology

Graduate Programs

- Applied Geology - Ph.D.
- Geology - M.S.

Department of Geology Faculty

- Chaudhary, Kuldeep (2017), Assistant Professor, Ph.D., University of Texas-Austin, 2013
- Clement, Susanne M. (1995), Associate Professor, Ph.D., Kent State University, 2005
- Green, Jeremy L. (2010), Assistant Professor, Ph.D., North Carolina State University, 2009
- Hacker, David B. (1989), Professor, Ph.D., Kent State University, 1998
- Herndon, Elizabeth (2014), Assistant Professor
- Holm, Daniel K. (1992), Professor and Department Chair, Ph.D., Harvard University, 1992
- Jefferson, Anne (2012), Assistant Professor, Ph.D., Oregon State University, 2006
- Ortiz, Joseph D. (2001), Professor, Ph.D., Oregon State University, 1995
- Rowan, Christopher (2013), Assistant Professor, Ph.D., University of Southampton, 2006
- Schweitzer, Carrie E. (1994), Professor, Ph.D., Kent State University, 2000
- Singer, David M. (2012), Assistant Professor, Ph.D., Stanford University, 2008
- Smith, Alison J. (1990), Professor, Ph.D., Brown University, 1991
- Taylor, Eric S. (2012), Associate Professor, Ph.D., The Ohio State University, 2012
- Wells, Neil A. (1984), Professor, Ph.D., University of Michigan, 1994
- Williams, Jeremy C. (2016), Assistant Professor, Ph.D., University of Massachusetts-Boston, 2014

Geology (GEOL)

GEOL 11040 HOW THE EARTH WORKS (KBS) 3 Credit Hours
Explores processes that shape Earth's landscapes (volcanism, flooding, landslides, sea-level rise, mountain building) and that are of vital interest to humans (earthquakes, groundwater, energy and mineral resources, climate change).

Prerequisite: None.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences, TAG Science, Transfer Module Natural Sciences

GEOL 11041 HOW THE EARTH WORKS LABORATORY (KBS) (KLAB) 1 Credit Hour

Lab experience with earth materials (mineral crystals, common and unusual rock specimens), Google Earth images, and experiments demonstrating processes at earth's surface such as groundwater pollution, flooding, and on-line earthquake simulations.

Pre/corequisite: GEOL 11040.

Schedule Type: Laboratory

Contact Hours: 3 lab

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences, Kent Core Basic Sciences Lab, TAG Science, Transfer Module Natural Sciences

GEOL 11042 EARTH AND LIFE THROUGH TIME (KBS) 3 Credit Hours

Explores major events in the history of Earth including mass extinctions, Snowball Earth, birth and death of oceans, growth of continents, explosion of life, dinosaurs, and the surprising inter-relatedness of earth and life processes.

Prerequisite: None.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences, TAG Science, Transfer Module Natural Sciences

GEOL 11043 EARTH AND LIFE THROUGH TIME LABORATORY (KBS) (KLAB) 1 Credit Hour

Lab experience with interesting fossils, rocks, and sedimentary features, a river process simulator, and the concept of deep time.

Pre/corequisite: GEOL 11042.

Schedule Type: Laboratory

Contact Hours: 3 lab

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences, Kent Core Basic Sciences Lab, TAG Science, Transfer Module Natural Sciences

GEOL 21062 ENVIRONMENTAL EARTH SCIENCE (KBS) 3 Credit Hours

Application of Earth Science to environmental problems, including natural resource extraction, water supply, pollution, waste disposal, landslides, floods and land use planning. Local field trip.

Prerequisite: None.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences, Transfer Module Natural Sciences

GEOL 21080 ALL ABOUT THE OCEANS (KBS) 3 Credit Hours

Explores the many fascinating (and some still little known) features and processes of the Earth's Oceans including mid-ocean ridges, hydrothermal vents, tsunamis, tides, rogue waves, marine life, and the role of the Ocean in climate change.

Prerequisite: None.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences, Transfer Module Natural Sciences

GEOL 22000 INTRODUCTORY GEOLOGY SEMINAR (ELR) 1 Credit Hour

Provides new Geology and Earth Science majors with an overview of career paths and opportunities within these majors. Components of the course include a journal club, informational presentations by geoscientists in industry, government, and academia, and skills training needed for the major. Required overnight field trip.

Prerequisite: None.

Schedule Type: Lecture

Contact Hours: 1 lecture

Grade Mode: Standard Letter

Attributes: Experiential Learning Requirement

GEOL 23063 EARTH MATERIALS I 4 Credit Hours

Occurrence, associations, characteristics, crystallography and crystal chemistry of common minerals. Laboratory identification emphasizing physical properties. Lecture three hours, lab two hours weekly. Required field trip. Pre/Corequisite CHEM 10060.

Prerequisite: GEOL 11040 and GEOL 11041.

Schedule Type: Combined Lecture and Lab

Contact Hours: 5 other

Grade Mode: Standard Letter

Attributes: TAG Science

GEOL 31070 EARTH MATERIALS II (WIC) 4 Credit Hours

Occurrence and origin of igneous, sedimentary and metamorphic rocks. Laboratory identification, description and classification of hand specimens. Lecture three hours, lab two hours weekly. Required field trip.

Prerequisite: GEOL 23063.

Schedule Type: Laboratory, Lecture

Contact Hours: 3 lecture, 2 lab

Grade Mode: Standard Letter

Attributes: Writing Intensive Course

GEOL 31080 STRUCTURAL GEOLOGY 4 Credit Hours

Mechanical principles of rock deformation. Structures in sedimentary igneous and metamorphic rocks. Lecture three hours lab two hours weekly. Required field trip.

Prerequisite: None.

Schedule Type: Combined Lecture and Lab

Contact Hours: 5 other

Grade Mode: Standard Letter

GEOL 32066 GEOMORPHOLOGY 4 Credit Hours

Earth's surface features as functions of geological structures, processes and time. Landform analysis using topographic maps and some stereographic aerial photos. Lecture three hours, lab two hours weekly. Trigonometry recommended.

Prerequisite: GEOL 11040 and GEOL 11041.

Schedule Type: Combined Lecture and Lab

Contact Hours: 4 other

Grade Mode: Standard Letter

GEOL 34061 INVERTEBRATE PALEONTOLOGY (WIC) 4 Credit Hours

Concepts applied to study of commonly preserved invertebrate organisms; identification of common North American fossils. Lecture three hours, lab two hours weekly. Required field trip.

Prerequisite: GEOL 11042 and GEOL 11043.

Corequisite: BSCI 10002 or 10110.

Schedule Type: Combined Lecture and Lab

Contact Hours: 5 other

Grade Mode: Standard Letter

Attributes: Writing Intensive Course

GEOL 40093 VARIABLE TITLE WORKSHOP IN GEOLOGY 1-8 Credit Hours

(Repeatable for credit) Workshop and/or training program focused on a specific professional or disciplinary topic.

Prerequisite: Special approval.

Schedule Type: Workshop

Contact Hours: 1-8 other

Grade Mode: Satisfactory/Unsatisfactory

GEOL 40095 SELECTED TOPICS IN GEOLOGY 1-3 Credit Hours

(Cross-listed with GEOL 50095) (Repeatable for credit) Selected topics presented by visiting professors or one-time offerings presented by regular faculty.

Prerequisite: 20 hours of geology courses.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Standard Letter

GEOL 40096 INDIVIDUAL INVESTIGATION IN GEOLOGY 1-3 Credit Hours

(Repeatable for credit) Directed field, laboratory and/or library research. Written report required. Open on special approval of faculty member directing work. Only 3 hours will be applied toward baccalaureate degree.

Prerequisite: Special approval.

Schedule Type: Individual Investigation

Contact Hours: 1-3 other

Grade Mode: Standard Letter-IP

GEOL 41025 GENERAL GEOPHYSICS 3 Credit Hours

(Cross-listed with GEOL 51025) Physics of Earth, seismology, geomagnetism, heat flow, radioactivity, geochronology, geotectonic models. Required field trip.

Prerequisite: GEOL 31070 and GEOL 31080 and MATH 12002; and PHY 13001 or PHY 23101.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 41073 GEOLOGY OF OHIO 3 Credit Hours

(Cross-listed with GEOL 51073) Minerals, rocks, fossils, structural geology, physiography, environmental geology and geologic resources. Required field trips. Does not satisfy requirements of geology major.

Prerequisite: Junior standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 41077 GEOLOGY OF THE NATIONAL PARKS 3 Credit Hours
(Cross-listed with GEOL 51077) Introduction to the geology of selected major national parks, emphasizing basic geological principles and the processes which have produced the spectacular scenery, rocks and fossils in each park. Not counted toward requirements for a major in geology.

Prerequisite: Junior standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 41079 ALL ABOUT DINOSAURS 3 Credit Hours
(Cross-listed with GEOL 51079) Dinosaurs (and some relatives) and their world, emphasizing how to interpret evidence concerning their history, biology and evolutionary relationships. Does not satisfy requirements of geology major.

Prerequisite: None.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 41080 TECTONICS AND OROGENY 3 Credit Hours
(Cross-listed with GEOL 51080) Introduces advanced concepts of plate tectonics and mountain building with emphasis on Western United States and Appalachians. Required field trip to New England.

Prerequisite: GEOL 31080.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 41082 ADVANCED STRUCTURAL GEOLOGY 3 Credit Hours
(Cross-listed with GEOL 51082) Theoretical and applied studies in structural geology, including mechanical, mathematical, model and field investigations. Required field trip.

Prerequisite: GEOL 31080.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 41092 SUMMER FIELD CAMP (ELR) 6 Credit Hours
(Cross-listed with GEOL 51092) Five weeks devoted to geologic mapping and solving structural and stratigraphic problems in Black Hills, S.D. Special fee on actual cost basis.

Prerequisite: GEOL 31070 and GEOL 31080.

Schedule Type: Practicum or Internship

Contact Hours: 42 other

Grade Mode: Standard Letter

Attributes: Experiential Learning Requirement

GEOL 42030 REMOTE SENSING 3 Credit Hours
(Cross-listed with GEOL 52030 and GEOL 72030 and GEOG 49230 and GEOG 59230 and GEOG 79230) Computer analysis of multispectral satellite datasets. Applications in Terrestrial Earth Science are emphasized.

Prerequisite: None.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 42035 SCIENTIFIC METHODS IN GEOLOGY 3 Credit Hours
(Cross-listed with GEOL 52035) Applying scientific methods to geologic data in the field and lab; models and sampling procedures. Collecting and analyzing data. Formulating and testing hypotheses. Provides background necessary for upper-level geology courses for majors. Lecture two hours, lab two hours weekly.

Prerequisite: None.

Schedule Type: Combined Lecture and Lab

Contact Hours: 2 lecture, 2 lab

Grade Mode: Standard Letter

GEOL 42065 WATERSHED HYDROLOGY 3 Credit Hours
(Slashed with GEOL 52065) Study of water movement, storage, and transformation across landscapes.

Prerequisite: Junior standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 42067 INTRODUCTORY HYDROGEOLOGY 3 Credit Hours
(Slashed with GEOL 52067) Occurrence of ground water in geologic materials; emphasizing utilization, conservation and management of ground water resources.

Prerequisite: Junior standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 42068 CONTAMINANT HYDROLOGY AND HYDROGEOLOGY 3 Credit Hours
(Cross-listed with GEOL 52068) An introduction to the basic principles of chemical and physical behavior of contaminants introduced by humans into the environment. Students are expected to understand concepts and work practical quantitative problems.

Prerequisite: GEOL 42067 and CHEM 10060 and CHEM 10061 and CHEM 10062 and CHEM 10063.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 42069 HYDROGEOCHEMISTRY 3 Credit Hours
(Cross-listed with GEOL 52069 and GEOL 72069) Processes and evolution of the chemical composition of water in the natural hydrologic cycle. Methods of hydrochemical interpretation applied to ground water and pollution problems. Lecture three hours weekly.

Prerequisite: 10 hours of chemistry.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 42074 ENVIRONMENTAL CORE AND WELL LOGGING 3 Credit Hours

(Cross-listed with GEOL 52074) Examination of subsurface processes and the distribution of stratigraphic layers using core and well logging techniques based on analysis of physical properties of sediment, rock and pore fluids. Applications to paleoclimate, hydrogeology, engineering geology, oil and gas exploration and environmental remediation.

Prerequisite: GEOL 31070.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 42078 ENGINEERING GEOLOGY 4 Credit Hours

(Cross-listed with GEOL 52078) Engineering properties of soils and rocks. Site evaluation for building foundations, dams, tunnels, and highways. Slope stability. Lecture three hours and lab two hours weekly.

Prerequisite: Geology (GEOL) or Earth Science (ESCI) major with Junior standing.

Schedule Type: Combined Lecture and Lab

Contact Hours: 4 other

Grade Mode: Standard Letter

GEOL 43040 PRINCIPLES OF GEOCHEMISTRY 3 Credit Hours

(Cross-listed with GEOL 53040) Introduction to chemical thermodynamics and its applications in solving geochemical problems. Distributions of elements and isotopes in the earth and laws governing these distributions.

Prerequisite: GEOL 31070; and MATH 12002; and CHEM 10060 and CHEM 10061.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 43042 ENVIRONMENTAL GEOCHEMISTRY 3 Credit Hours

(Cross-listed with GEOL 53042 and GEOL 73042) Explores chemical processes that influence the natural environment, including anthropogenic impacts. Topics include atmospheric chemistry and air pollution, energy and climate change, toxic organic compounds, water chemistry and water pollution, metals, soils, sediments and waste disposal. Environmental problem solving using steady state and non-steady state box models, thermodynamics and energy transfer, and chemical reactions and equilibria is emphasized. Required half-day field trip.

Prerequisite: CHEM 10060 and CHEM 10061.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 43044 ENVIRONMENTAL ISOTOPES 3 Credit Hours

(Cross-listed with GEOL 53044 and GEOL 73044) Deals with the fundamentals of isotope geochemistry and the application of primarily light stable isotopes (H, O, C, N) to earth system processes (involving the hydrosphere, biosphere, and upper geosphere).

Prerequisite: CHEM 10060 and CHEM 10061.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 43066 OPTICAL PETROGRAPHY 3 Credit Hours

(Cross-listed with GEOL 53066) Theory of optical crystallography and the microscopic examination and identification of igneous, sedimentary and metamorphic rocks in thin section. Lecture two hours, lab two hours weekly.

Prerequisite: GEOL 31070.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 44052 GLACIERS AND GLACIATION 3 Credit Hours

(Cross-listed with GEOG 41052, GEOG 51052 and GEOG 71052)

Examination of how glacial ice masses change the shape of the earth's surface, how they are integral to climate and sea level change, and how they pose high risk hazards.

Prerequisite: GEOG 21062 or GEOL 11040.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 44070 SEDIMENTOLOGY AND STRATIGRAPHY 4 Credit Hours

(Slashed with GEOL 54070) Students are introduced to the principles regarding the systematics of sedimentary rocks and the relationships between geologic formations at various spatial and temporal scales. Lectures are integrated with readings from the open literature and required labs and field trips.

Prerequisite: GEOL 31070.

Schedule Type: Combined Lecture and Lab

Contact Hours: 3 lecture, 2 lab

Grade Mode: Standard Letter

GEOL 44074 PALEOCEANOGRAPHY 3 Credit Hours

A broad spectrum of geological approaches, including paleontology, geochemistry and stratigraphy is employed to interpret the history of earth's oceans.

Prerequisite: None.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 50093 VARIABLE TITLE WORKSHOP IN GEOLOGY 1-8 Credit Hours

(Repeatable for credit) Workshop or training program focused on a specific professional or disciplinary topic within geology.

Prerequisite: Graduate standing and special approval.

Schedule Type: Workshop

Contact Hours: 1-8 other

Grade Mode: Satisfactory/Unsatisfactory

GEOL 50095 SELECTED TOPICS IN GEOLOGY 1-3 Credit Hours

(Cross-listed with GEOL 40095) (Repeatable for credit) Selected topics presented by visiting professors or one-time offerings presented by regular faculty.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Standard Letter

GEOL 51025 GENERAL GEOPHYSICS 3 Credit Hours

Physics of Earth. Seismology, geomagnetism; heat flow, radioactivity, geochronology, gravity and isostasy, geotectonic models. Lecture 3 hours weekly. Required field trip.

Prerequisite: graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 51073 GEOLOGY OF OHIO 3 Credit Hours

(Cross-listed with GEOL 41073) Minerals, rocks, fossils, structural geology, physiography, environmental geology, geologic resources. Required field trips. Does not satisfy requirements for major in geology.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 51077 GEOLOGY OF THE NATIONAL PARKS 3 Credit Hours
(Cross-listed with GEOL 41077) Introduction to the geology of selected major national parks, emphasizing basic geological principles and the processes which have produced the spectacular scenery, rocks and fossils in each park. Not counted toward requirements for a major in geology.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 51079 ALL ABOUT DINOSAURS 3 Credit Hours
(Cross-listed with GEOL 41079) Dinosaurs (and some relatives) and their world, emphasizing how to interpret evidence concerning their history, biology and evolutionary relationships. Does not satisfy requirements of geology major.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 51080 TECTONICS AND OROGENY 3 Credit Hours
Introduces advanced concepts of plate tectonics and mountain building with emphasis on Western United States and Appalachians. Required field trip to New England.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 51082 ADVANCED STRUCTURAL GEOLOGY 3 Credit Hours
(Cross-listed with GEOL 41082) Theoretical and applied studies in structural geology, including mechanical, mathematical, model and field investigations.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 51092 SUMMER FIELD CAMP 6 Credit Hours
(Repeatable for credit) Five weeks devoted to geologic mapping and solving structural and stratigraphic problems in Black Hills, S.D. Special fee on actual cost basis.

Prerequisite: Graduate standing.

Schedule Type: Practicum or Internship

Contact Hours: 42 other

Grade Mode: Standard Letter-IP

GEOL 52030 REMOTE SENSING 3 Credit Hours
(Cross-listed with GEOL 42030 and GEOL 72030 and GEOG 41052 and GEOG 51052 and GEOG 71052) Computer analysis of multispectral satellite datasets. Applications in Terrestrial Earth Science are emphasized.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 52035 SCIENTIFIC METHODS IN GEOLOGY 3 Credit Hours
(Cross-listed with GEOL 42035) Applying scientific methods to geologic data in the field and lab; models and sampling procedures. Collecting and analyzing data. Formulating and testing hypotheses. Lecture two hours, lab two hours.

Prerequisite: Graduate standing.

Schedule Type: Combined Lecture and Lab

Contact Hours: 2 lecture, 2 lab

Grade Mode: Standard Letter

GEOL 52065 WATERSHED HYDROLOGY 3 Credit Hours
(Slashed with GEOL 42065) Study of water movement, storage, and transformation across landscapes.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 52067 INTRODUCTORY HYDROGEOLOGY 3 Credit Hours
(Slashed with GEOL 42067) Occurrence of ground water in geologic materials; emphasizing utilization, conservation and management of ground water resources.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 52068 CONTAMINANT HYDROLOGY AND HYDROGEOLOGY 3 Credit Hours
(Cross-listed with GEOL 42068) An introduction to the basic principles of chemical and physical behavior of contaminants introduced by humans into the environment. Students are expected to understand concepts and work practical quantitative problems.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 52069 HYDROGEOCHEMISTRY 3 Credit Hours
(Cross-listed with GEOL 42069 and GEOL 72069) Processes and evolution of the chemical composition of water in the natural hydrologic cycle. Methods of hydrochemical interpretation applied to ground water and pollution problems. Lecture three hours weekly.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 52074 ENVIRONMENTAL CORE AND WELL LOGGING 3 Credit Hours

(Cross-listed with GEOL 42074) Examination of subsurface processes and the distribution of stratigraphic layers using core and well logging techniques based on analysis of physical properties of sediment, rock and pore fluids. Applications to paleoclimate, hydrogeology, engineering geology, oil and gas exploration and environmental remediation.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 52078 ENGINEERING GEOLOGY 4 Credit Hours

(Cross-listed with GEOL 42078) Engineering properties of soils and rocks. Site evaluation for building foundations, dams, tunnels and highways. Slope stability. Lecture three hours and lab two hours weekly.

Prerequisite: Graduate standing.

Schedule Type: Combined Lecture and Lab

Contact Hours: 4 other

Grade Mode: Standard Letter

GEOL 53040 PRINCIPLES OF GEOCHEMISTRY 3 Credit Hours

(Cross-listed with GEOL 43040) Introduction to chemical thermodynamics and its applications in solving geochemical problems. Distributions of elements and isotopes in the Earth and laws governing these distributions.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 53042 ENVIRONMENTAL GEOCHEMISTRY 3 Credit Hours

(Cross-listed with GEOL 43042 and GEOL 73042) Explores chemical processes that influence the natural environment including anthropogenic impacts. Topics include atmospheric chemistry and air pollution, energy and climate change, toxic organic compounds, water chemistry and water pollution, metals, soils, sediments and waste disposal. Environmental problem solving using steady state and non-steady state box models, thermodynamics and energy transfer, and chemical reactions and equilibria is emphasized. Required half-day field trip.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 53044 ENVIRONMENTAL ISOTOPES 3 Credit Hours

(Cross-listed with GEOL 43044 and GEOL 73044) Deals with the fundamentals of isotope geochemistry and the application of primarily light stable isotopes (H, O, C, N) to earth system processes (involving the hydrosphere, biosphere, and upper geosphere).

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 53066 OPTICAL PETROGRAPHY 3 Credit Hours

(Cross-listed with GEOL 43066) Theory of optical crystallography and the microscopic examination and identification of igneous, sedimentary and metamorphic rocks in thin section. Lecture two hours, laboratory two hours weekly.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 54052 GLACIERS AND GLACIATION 3 Credit Hours

(Cross-listed with GEOG 41052, GEOG 51052 and GEOG 71052) Examination of how glacial ice masses change the shape of the earth's surface, how they are integral to climate and sea level change and how they pose high risk hazards.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 54070 SEDIMENTOLOGY AND STRATIGRAPHY 4 Credit Hours

(Cross-listed with GEOL 44070) Students are introduced to the principles regarding the systematics of sedimentary rocks and the relationships between geologic formations at various spatial and temporal scales. Lectures are integrated with readings from the open literature and required labs and field trips.

Prerequisite: Graduate standing.

Schedule Type: Combined Lecture and Lab

Contact Hours: 3 lecture, 2 lab, 1 other

Grade Mode: Standard Letter

GEOL 54074 PALEOCEANOGRAPHY 3 Credit Hours

(Cross-listed with GEOL 44074) A broad spectrum of geological approaches, including paleontology, geochemistry and stratigraphy is employed to interpret the history of Earth's oceans.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 60080 RESEARCH ORIENTATION 1 Credit Hour

(Cross-listed with GEOL 70080) Faculty research presentations; thesis/dissertation proposal preparation; discussion of professional organizations, preparation of manuscripts and oral presentation of papers.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 1 lecture

Grade Mode: Satisfactory/Unsatisfactory

GEOL 60084 GEOLOGY GRADUATE STUDENT ORIENTATION 1 Credit Hour

(Slashed with GEOL 70084) Introduction to departmental resources, procedures, and expectations as well as approaches to successfully conduct research at a graduate level. Training and experience in presentation of data and college teaching of applied geology, as well as a discussion forum on professional ethics and responsibilities.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 1 lecture

Grade Mode: Satisfactory/Unsatisfactory

GEOL 60091 SEMINAR 1-2 Credit Hours

(Cross-listed with GEOL 70091) (Repeatable for credit) Specialized topics in geology. Precise title to be inserted in schedule of classes.

Prerequisite: Graduate standing.

Schedule Type: Seminar

Contact Hours: 1-2 other

Grade Mode: Standard Letter-S/U

GEOL 60094 COLLEGE TEACHING OF APPLIED GEOLOGY 1 Credit Hour

(Cross-listed with GEOL 70094) (Repeatable for credit) Training and experience in presentation of data and college teaching of applied geology, as well as a discussion forum on professional ethics and responsibilities.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 1 lecture

Grade Mode: Standard Letter-S/U

GEOL 60095 SELECTED TOPICS IN GEOLOGY 1-3 Credit Hours

(Repeatable for credit) Selected topics presented by visiting professors or one-time offerings presented by regular faculty.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Standard Letter

GEOL 60098 RESEARCH 1-15 Credit Hours

(Repeatable for credit) Research for master's level students. Credits earned may be applied toward degree if department approves.

Prerequisite: Graduate standing.

Schedule Type: Research

Contact Hours: 1-15 other

Grade Mode: Satisfactory/Unsatisfactory-IP

GEOL 60199 THESIS I 2-6 Credit Hours

Thesis students must register for a total of 6 hours, 2 to 6 hours in a single semester distributed over several semesters if desired.

Prerequisite: Graduate standing.

Schedule Type: Masters Thesis

Contact Hours: 2-6 other

Grade Mode: Satisfactory/Unsatisfactory-IP

GEOL 60299 THESIS II 2 Credit Hours

Thesis students must continue registration each semester until all degree requirements are met.

Prerequisite: GEOL 60199 and Graduate standing.

Schedule Type: Masters Thesis

Contact Hours: 2 other

Grade Mode: Satisfactory/Unsatisfactory-IP

GEOL 61093 WORKSHOP IN COLLEGE TEACHING 1-2 Credit Hours

(Repeatable for credit) Workshop in college teaching.

Prerequisite: Graduate standing.

Schedule Type: Workshop

Contact Hours: 1-2 other

Grade Mode: Satisfactory/Unsatisfactory

GEOL 62011 HYDROLOGY 3 Credit Hours

(Cross-listed with GEOL 72011) Introduction to hydrologic measurements, properties of water precipitation, evapotranspiration runoff computations, streamflow and flood routing.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 62068 ADVANCED HYDROGEOLOGY 3 Credit Hours

(Cross-listed with GEOL 72068) Quantitative approach to occurrence of ground water; methods of investigation, evaluation and development of ground water resources emphasizing optimization and maximal exploitation without environmental changes.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 62079 ADVANCED ENGINEERING GEOLOGY 3 Credit Hours

(Cross-listed with GEOL 72079) Role of geology in site selection, design and construction relative to dams, tunnels, highways, slope stability and nuclear power plants. Selected case histories. Lecture three hours weekly. Field trip and term paper required.

Prerequisite: GEOL 4/52078 and Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 62082 INTRODUCTION TO SOIL MECHANICS 4 Credit Hours

(Cross-listed with GEOL 72082) Engineering properties and engineering behavior of soils including classification properties, compaction permeability strength and compressibility. Lecture three hours and lab two hours weekly.

Prerequisite: Graduate standing.

Schedule Type: Combined Lecture and Lab

Contact Hours: 5 other

Grade Mode: Standard Letter

GEOL 62083 ROCK SLOPE STABILITY 3 Credit Hours

(Cross-listed with GEOL 72083) Provide information used to recognize, avoid, design for, control and correct slope movements in rocks; determination of shear strength along rock discontinuities; stability analysis of rock slopes.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 62084 FOUNDATION ENGINEERING 3 Credit Hours

(Cross-listed with GEOL 72084) Seepage and drainage of foundation soils. Subsurface investigations. Principles, design and construction of shallow and deep foundations. Earth retaining structures. Lecture three hours weekly.

Prerequisite: GEOL 42078 or 52078 or 72082; and Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 63063 SEDIMENTARY PETROLOGY 3 Credit Hours

(Cross-listed with GEOL 73063) Classification, texture, composition, provenance and diagenesis of sandstones and carbonates, following review of optical mineralogy. Petrographic microscopy and other laboratory techniques are emphasized.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 63067 CARBONATE ROCKS 3 Credit Hours

(Cross-listed with GEOL 73067) Basic principles of carbonate sedimentology including composition, classification, origin and distribution of carbonate sediments their diagenesis and lithification.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 64028 PALEOECOLOGY 3 Credit Hours

(Cross-listed with GEOL 74028) Relationships between ancient organisms and their environments, as interpreted from fossils, enclosing rock strata and recent analogs. Field and laboratory studies. Saturday field trips.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 64030 SYSTEMATIC INVERTEBRATE PALEONTOLOGY I 3 Credit Hours

(Cross-listed with GEOL 74030) Detailed investigation and examination of important literature concerning taxonomic characters of invertebrate phyla: Protista, Porifera, Cnidaria and Bryozoa. Numerous oral reports, specimen examination.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 64032 SYSTEMATIC INVERTEBRATE PALEONTOLOGY II 3 Credit Hours

(Cross-listed with GEOL 74032) Detailed investigation and examination of important literature concerning taxonomic characters of invertebrate phyla: Brachiopoda, Mollusca, Arthropoda and Echinodermata. Numerous oral reports, specimen examination.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 64036 CENOZOIC CLIMATE CHANGE 3 Credit Hours

(Cross-listed with GEOL 74036) An overview of the concepts and principles involved in interpreting global and hemispheric Cenozoic climate change (past 65 million years). Emphasis on particular temporal and spatial scales and cycles. Extensive reading in scientific journals.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 64038 PALEOLIMNOLOGY 3 Credit Hours

An overview of significant topics and applications in paleolimnology of Holocene (last 10,000 years) and Pleistocene (last 2 million years) records, including current issues in environmental and climatic reconstruction. Extensive reading expected.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 64065 SEDIMENTOLOGY 3 Credit Hours

(Cross-listed with GEOL 74065) Fluid dynamics, grain transport, sedimentary structures, granulometry, bedform and facies sequences, and facies architecture. Interpretation of continental and marine clastic depositional environments and processes.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 70080 RESEARCH ORIENTATION 1 Credit Hour

(Cross-listed with GEOL 60080) Faculty research presentations; thesis/dissertation proposal preparation; discussion of professional organizations, preparation of manuscripts and oral presentation of papers.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 1 lecture

Grade Mode: Satisfactory/Unsatisfactory

GEOL 70084 GEOLOGY GRADUATE STUDENT ORIENTATION 1 Credit Hour

(Slashed with GEOL 60084) Introduction to departmental resources, procedures, and expectations as well as approaches to successfully conduct research at a graduate level. Training and experience in presentation of data and college teaching of applied geology, as well as discussion forum on professional ethics and responsibilities.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 1 lecture

Grade Mode: Satisfactory/Unsatisfactory

GEOL 70091 SEMINAR 1-2 Credit Hours

(Cross-listed with GEOL 60091) (Repeatable for credit) Specialized topics in geology. Precise title to be inserted in schedule of classes.

Prerequisite: Doctoral standing.

Schedule Type: Seminar

Contact Hours: 1-2 other

Grade Mode: Standard Letter-S/U

GEOL 70093 VARIABLE TITLE WORKSHOP IN GEOLOGY 1-8 Credit Hours

(Repeatable for credit) Workshop and/or training program, of varying duration focused on a specific professional or disciplinary topic.

Prerequisite: Special approval and Doctoral standing.

Schedule Type: Workshop

Contact Hours: 1-8 other

Grade Mode: Satisfactory/Unsatisfactory

GEOL 70094 COLLEGE TEACHING OF APPLIED GEOLOGY 1 Credit Hour

(Cross-listed with GEOL 60094) (Repeatable for credit) Training and experience in presentation of data and college teaching of applied geology, as well as a discussion forum on professional ethics and responsibilities.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 1 lecture

Grade Mode: Standard Letter-S/U

GEOL 71093 WORKSHOP IN COLLEGE TEACHING 1-2 Credit Hours

(Repeatable for credit) Workshop in college teaching.

Prerequisite: Doctoral standing.

Schedule Type: Workshop

Contact Hours: 1-2 other

Grade Mode: Satisfactory/Unsatisfactory

GEOL 72011 HYDROLOGY 3 Credit Hours

(Cross-listed with GEOL 62011) Introduction to hydrologic measurements, properties of water precipitation, evapotranspiration, runoff computations, streamflow and flood routing.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 72030 REMOTE SENSING 3 Credit Hours

(Cross-listed with GEOL 42030 and GEOL 52030 and GEOG 41052 and GEOG 51052 and GEOG 71052) Computer analysis of multispectral satellite datasets. Applications in Terrestrial Earth Science are emphasized.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 72068 ADVANCED HYDROGEOLOGY 3 Credit Hours

Quantitative approach to occurrence of ground water; methods of investigation evaluation and development of ground water resources emphasizing optimization and maximal exploitation without environmental changes.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 72069 HYDROGEOCHEMISTRY 3 Credit Hours

(Cross-listed with GEOL 42069 and GEOL 52069) Processes and evolution of the chemical composition of water in the natural hydrologic cycle. Methods of hydrochemical interpretation applied to ground water and pollution problems. Lecture three hours weekly.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 72079 ADVANCED ENGINEERING GEOLOGY 3 Credit Hours

(Cross-listed with GEOL 62079) Role of geology in site selection, design and construction relative to dams tunnels highways slope stability and nuclear power plants. Selected case histories. Lecture three hours weekly. Field trip and term paper required.

Prerequisite: GEOL 4 52078 and Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 72082 INTRODUCTION TO SOIL MECHANICS 4 Credit Hours

(Cross-listed with GEOL 62082) Engineering properties and engineering behavior of soils including classification properties, compaction permeability strength and compressibility. Lecture three hours and lab two hours weekly.

Prerequisite: Doctoral standing.

Schedule Type: Combined Lecture and Lab

Contact Hours: 5 other

Grade Mode: Standard Letter

GEOL 72083 ROCK SLOPE STABILITY 3 Credit Hours

Provide information used to recognize, avoid design for control and correct slope movements in rocks determination of shear strength along rock discontinuities stability analysis of rock slopes.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 72084 FOUNDATION ENGINEERING 3 Credit Hours

(Cross-listed with GEOL 62084) Seepage and drainage of foundation soils. Subsurface investigations. Principles design and construction of shallow and deep foundations. Earth retaining structures. Lecture three hours weekly.

Prerequisite: GEOL 42078 or 52078 or 42082 or 52082 or 72082; and Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 73042 ENVIRONMENTAL GEOCHEMISTRY 3 Credit Hours

(Cross-listed with GEOL 43042 and GEOL 53042) Explores chemical processes that influence the natural environment including anthropogenic impacts. Topics include atmospheric chemistry and air pollution, energy and climate change, toxic organic compounds, water chemistry and water pollution, metals, soils, sediments and waste disposal. Environmental problem solving using steady state and non-steady state box models, thermodynamics and energy transfer, and chemical reactions and equilibria is emphasized. Required half-day field trip.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 73044 ENVIRONMENTAL ISOTOPES 3 Credit Hours

(Cross-listed with GEOL 43044 and GEOL 53044) Deals with the fundamentals of isotope geochemistry and the application of primarily light stable isotopes (H, O, C, N) to earth system processes (involving the hydrosphere, biosphere, and upper geosphere).

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 73063 SEDIMENTARY PETROLOGY 3 Credit Hours

Classification, texture composition provenance and diagenesis of sandstones and carbonates following review of optical mineralogy. Petrographic microscopy and other laboratory techniques are emphasized.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 73067 CARBONATE ROCKS 3 Credit Hours

(Cross-listed with GEOL 63067) Basic principles of carbonate sedimentology including composition, classification origin and distribution of carbonate sediments their diagenesis and lithification.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 74028 PALEOECOLOGY 3 Credit Hours

(Cross-listed with GEOL 64028) Relationships between ancient organisms and their environments, as interpreted from fossils, enclosing rock strata and recent analogs. Field and laboratory studies. Saturday field trips.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 74030 SYSTEMATIC INVERTEBRATE PALEONTOLOGY I 3 Credit Hours

(Cross-listed with GEOL 64030) Detailed investigation and examination of important literature concerning taxonomic characters of invertebrate phyla: Protista, Porifera, Cnidaria and Bryozoa. Numerous oral reports, specimen examination.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 74032 SYSTEMATIC INVERTEBRATE PALEONTOLOGY II 3 Credit Hours

(Cross-listed with GEOL 64032) Detailed investigation and examination of important literature concerning taxonomic characters of invertebrate phyla: Brachiopoda, Mollusca, Arthropoda and Echinodermata. Numerous oral reports, specimen examination.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 74036 CENOZOIC CLIMATE CHANGE 3 Credit Hours

(Cross-listed with GEOL 64036) An overview of the concepts and principles involved in interpreting global and hemispheric Cenozoic climate change (past 65 million years). Emphasis on particular temporal and spatial scales and cycles. Extensive reading in scientific journals.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 74038 PALEOLIMNOLOGY 3 Credit Hours

An overview of significant topics and applications in paleolimnology of Holocene (last 10,000 years) and Pleistocene (last 2 million years) records, including current issues in environmental and climatic reconstruction. Extensive reading expected.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 74052 GLACIERS AND GLACIATION 3 Credit Hours

(Cross-listed with GEOG 41052, GEOG 51052 and GEOG 71052)

Examination of how glacial ice masses change the shape of the earth's surface, how they are integral to climate and sea level change and how they pose high risk hazards.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 74065 SEDIMENTOLOGY 3 Credit Hours

(Cross-listed with GEOL 64065) Fluid dynamics, grain transport, sedimentary structures, granulometry, bedform and facies sequences and facies architecture. Interpretation of continental and marine clastic depositional environments and processes.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

GEOL 80091 SEMINAR IN APPLIED GEOLOGY 1-2 Credit Hours

(Repeatable for credit) Specialized topics in applied geology. Precise title to be inserted in schedule of classes.

Prerequisite: Doctoral standing.

Schedule Type: Seminar

Contact Hours: 1-2 other

Grade Mode: Standard Letter-S/U

GEOL 80095 ADVANCED TOPICS IN GEOLOGY 1-3 Credit Hours

(Repeatable for credit) Advanced topics presented by visiting professors or one-time offerings presented by regular faculty.

Prerequisite: Special approval and Doctoral standing.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Standard Letter

GEOL 80098 RESEARCH 1-15 Credit Hours

(Repeatable for credit) Research for doctoral students. Credits earned may be applied toward degree if department approves.

Prerequisite: Doctoral standing.

Schedule Type: Research

Contact Hours: 1-15 other

Grade Mode: Satisfactory/Unsatisfactory-IP

GEOL 80199 DISSERTATION I 15 Credit Hours

(Repeatable for credit) Doctoral dissertation, for which registration in at least two semesters is required first of which will be semester in which dissertation work is begun and continuing until the completion of 30 hours.

Prerequisite: Admission to candidacy for Doctoral degree and Doctoral standing.

Schedule Type: Dissertation

Contact Hours: 15 other

Grade Mode: Satisfactory/Unsatisfactory-IP

GEOL 80299 DISSERTATION II 15 Credit Hours

(Repeatable for credit) Continuing registration required of doctoral students who have completed the initial 30 hours of dissertation, continuing until all degree requirements are met.

Prerequisite: GEOL 80199 and Doctoral standing.

Schedule Type: Dissertation

Contact Hours: 15 other

Grade Mode: Satisfactory/Unsatisfactory-IP