Course Change Request

New Course Proposal

Date Submitted: 01/20/22 2:51 pm

Viewing: GEOL 540 : Modern Methods in Geology

Last edit: 02/17/22 11:12 am

Changes proposed by: muhen

Programs referencing this course

: Geology and Earth Sciences, PhD

In Workflow

1. **AOES Chair**
2. **SC Curriculum Committee**
3. SC Associate Dean
4. Assoc Provost-Graduate
5. Registrar-Courses
6. Banner

Approval Path

1. 01/20/22 2:50 pm Mark Uhen (muhen): Rollback to Initiator
2. 01/31/22 2:27 pm Mark Uhen (muhen): Approved for AOES Chair

Are you completing this form on someone else's behalf?

No

Effective Term: Fall 2022

Subject Code: GEOL - Geology

Course Number: 540

Bundled Courses:

Is this course replacing another course? No

Equivalent Courses:

Catalog Title: Modern Methods in Geology

Banner Title: Modern Methods in Geology

Will section titles vary by semester? No

Credits: 3

Schedule Type: Lecture

Hours of Lecture or Seminar per week: 3

Repeatable: May be only taken once for credit, limited to 3 attempts (N3)

Max Allowable Credits: 9

Default Grade Mode: Graduate Regular

Recommended Prerequisite(s):

Recommended Corequisite(s):

Required Prerequisite(s) / Corequisite(s) (Updates only):

Registrar's Office Use Only - Required Prerequisite(s)/Corequisite(s):

And/Or	(	Course/Test Code	Min Grade/Score	Academic Level	)	Concurrency?

Registration Restrictions (Updates only):

Registrar's Office Use Only - Registration Restrictions:

Field(s) of Study:

Class(es):

Level(s):

Degree(s):

School(s):

Catalog Description:

An introduction to common types of datasets (i.e. geologic map products, reflection seismic data, outcrop photogrammetry) that geologists use in the workforce (both public and private sector) to complement field-based and observational methods of geology (such as outcrop, core or sample descriptions). The class will

focus on both learning about the applications of the various data types as well as developing skills in accessing, plotting, and making geologic interpretations of the data.

Justification:

What: Creating a new course

Why: This course will provide a fundamental foundation of analytical methods used in large scale and field data studies in geology.

Does this course cover material which crosses into another department? No

Learning Outcomes:

Students will gain familiarity and skill with digital and analog methods for producing and analyzing both observational (e.g. outcrop descriptions) and quantitative (e.g. digital elevation datasets) geologic data sets. Students will also be introduced to GIS and digital field methods in geology that are commonly applied in geoscience careers. By the end of the course students will be able to access, manipulate, and interpret digital geologic map data in various formats; download, manipulate and interpret satellite and airborne digital elevation datasets; create, manipulate and interpret outcrop photogrammetry models; as well as interpret common geophysical datasets including reflection seismic and geophysical well data.

Attach Syllabus

GEOL 540 Modern Methods in Geology.pdf

Additional Attachments

Staffing:

Dr. Paul Betka will teach this course.

Relationship to Existing Programs:

This course will primarily be used by students in the ESS MS program and in the proposed Geology and Earth Sciences PhD.

Relationship to Existing Courses:

GEOL 340 and 540 will be taught synchronously. The undergraduate course (340) was designed for GEOL majors who have finished their introductory classes but have not yet completed all of the core GEOL. requirements and have not yet had structural geology (GEOL 401). The graduate version of this course (540) will parallel the undergraduate course, but graduate students will be expected to perform more in-depth analysis and interpretation of the datasets utilizing skills that they would have learned in all of their undergraduate courses (structure, sed-strat etc). Graduate students will also be expected to complete a term project in support of their thesis or dissertation work that utilizes any combination of datasets or techniques that we discuss in class. For example, the virtual mapping exercises that graduate students will complete include a complex geological landscape, whereas the undergraduates are expected to map a very simple feature in order to focus on more on the basics of map reading/plotting. Similarly, for the map analysis exercises, undergraduates will be expected to extract only the first order features, whereas

graduate students will learn how to carry-out more quantitative analysis of map data, including structural analysis.

Additional Comments:

Reviewer Comments

Mark Uhen (muhen) (01/20/22 2:50 pm): Rollback: update

Key: 17517

GEOL 540: Modern Methods in Geology
Syllabus

Instructor: Dr. Paul Betka
Email: pbetka@gmu.edu
Office hours: by appointment
Class meetings will be in EXPL 1005: F 3-5:45p.

Course Description: An introduction to common types of datasets (i.e. geologic map products, reflection seismic data, outcrop photogrammetry) that geologists use in the workforce (both public and private sector) to complement field-based and observational methods of geology (such as outcrop, core or sample descriptions). The class will focus on both learning about the applications of the various data types as well as developing skills in accessing, plotting, and making geologic interpretations of the data.

Learning outcomes: Students will gain familiarity and skill with digital and analog methods for producing and analyzing both observational (e.g. outcrop descriptions) and quantitative (e.g. digital elevation datasets) geologic data sets. Students will also be introduced to GIS and digital field methods in geology that are commonly applied in geoscience careers. By the end of the course students will be able to access, manipulate, and interpret digital geologic map data in various formats; download, manipulate and interpret satellite and airborne digital elevation datasets; create, manipulate and interpret outcrop photogrammetry models; as well as interpret common geophysical datasets including reflection seismic and geophysical well data.

Part I (8 weeks): Geologic maps and map products.
Geologic maps represent the intersection of subsurface geology in 3D (4D actually, 3D + time!) with the topographic surface of the earth. A wealth of both quantitative and qualitative information can be gleaned by learning to read and interpret geologic maps. In Part I of the class students will learn to make geologic interpretations and extract quantitative data from geologic maps. Students will also learn basic GIS work-flows for accessing open-source geologic map data (like SRTM (global) and 3DEP (national) DEMs, as well as USGS and Statemaps) to compile geologic maps.

Part II (3 weeks): Outcrop digital datasets.
Over the past decade or so, advances in digital photography, remote sensing equipment, and consumer computer processing power have led to the development of very-high resolution (mm-scale) digital outcrop models using tools like Gigapans (2D) and outcrop photogrammetry (3D) and LiDAR. What used to be prohibitively expensive imaging equipment for most field-geologists is now readily available on consumer products, opening up a wealth of possibilities for the geologist interested in high-resolution quantitative datasets. Part II of the class will focus on geologic applications of modern digital field techniques, including an introduction to tablet and smartphone-based geologic mapping apps like StraboSpot and FieldMove.

Part III (3 weeks): Subsurface datasets.
Many professional applications of geology rely heavily on subsurface datasets for understanding economic or environmental impacts of geologic resources (e.g. groundwater, hydrocarbons, mineral resources). Part III of the class will focus on introducing common types of subsurface datasets including seismic reflection images and depth/thickness maps.

Assessment: The final grade for this class will be a combination of weekly assignments and a data synthesis project. There are no tests, mid-term, or final exams.

Weekly homework assignments (14)……..……100%
Assignment score (80%), final project (20%).

Grade scale:
A+ = 97 - 100%, A = 94 – 97%, A- = 90 – 94%, B+ = 87 – 90%, B = 84 - 87%, B- = 80 - 84%, C = 70 - 80%, F = 0 - 70%

DISABILITIES: Students with disabilities or medical conditions that affect classroom performance should contact GMU Disability Support Services immediately at 993-2474. NOTE: Students will not receive any disability accommodations unless official GMU paperwork from Disability Resource Office is provided for and signed by Dr. Paul Betka.

HONOR CODE: Adherence to the GMU honor code is expected of all students. Exercises are expected to be individual efforts, unless teams are specifically assigned. Students are encouraged to discuss the concepts and procedures among themselves, but each student is expected to complete the lab assignment individually using their own words.

To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University Community and with the desire for greater academic and personal achievement, we, the student members of the university community, have set forth this Honor Code: Student Members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work.
[http://academicintegrity.gmu.edu/honorcode]

Week	Friday class	Assignment
1: Aug. 28	**Syllabus; Lect. 1 Map basics, strike and dip, topography.**	University of Leeds, 3D exercises. Strike/Dip, Strike lines, Rule of Vs.
2: Sept. 4	**Geologic mapping and field basics**	Three River Hills mapping assignment
3: Sept. 11	**Geologic cross sections and 3D map problems**	Three River Hills cross section
4: Sept. 18	**Digital map data types, map projections. QGIS**	Install QGIS v. 3.10. Load West Virginia data, experiment with map projections and measurements. Load GMDE data.
5: Sept. 25	**Grand Canyon project wk 1**	Download Grand Canyon datasets, load in QGIS and GMDE.
6: Oct. 2	**Grand Canyon project wk 2**	Grand Canyon map and stratigraphic section
7: Oct. 9	**Grand Tetons Project wk 1**	Download Grand Tetons datasets, load in QGIS and GMDE
8: Oct. 16	**Grand Tetons Project wk 2**	Teton Fault scarp map and cross section
9: Oct 23	**Digital geological mapping**	Virginia geology digital mapping exercise
10: Oct. 30	**Organizing digital datasets for GIS**	Virginia geology data synthesis
11: Nov. 6	**Digital outcrop data**	Photogrammetry exercises
12: Nov. 13	**Introduction to subsurface datasets and seismic reflection**	Subsurface datasets 1
13: Nov. 20	**Isopach, Isochore, and Isochron maps**	Subsurface datasets 2
14: Nov. 27	**Thanksgiving Break**	
15: Dec. 4	**Exploration using subsurface data**	Subsurface datasets 3 **Data synthesis project presentations***

*Graduate students must complete a data synthesis project. Please choose any type of digital geological data that is appropriate for your thesis or dissertation and compile some form of data synthesis product using one of more of the techniques we cover in class. For example, your final product might be some form of a geologic map, or a photogrammetry model of an important outcrop or specimen of your choosing. Prepare

a 20-minute presentation and 5-10 page written report outlining your term project findings. Final project presentations are due on the last day of class.