GEOL M04: MINERALOGY

Originator
rputnam

College
Moorpark College

Discipline (CB01A)
GEOL - Geology

Course Number (CB01B)
M04

Course Title (CB02)
Mineralogy

Banner/Short Title
Mineralogy

Credit Type
Credit

Start Term
Fall 2022

Catalog Course Description
Introduces basic concepts of mineralogy including crystallography, mineral chemistry, mineral origin, occurrence, and associations. Emphasizes, in the lab component, the identification of minerals in hand specimen and thin section and examination of field relations of minerals in outcrop.

Additional Catalog Notes
Requires two days of field trips on weekends.

Taxonomy of Programs (TOP) Code (CB03)
1914.00 - Geology

Course Credit Status (CB04)
D (Credit - Degree Applicable)

Course Transfer Status (CB05) (select one only)
A (Transferable to both UC and CSU)

Course Basic Skills Status (CB08)
N - The Course is Not a Basic Skills Course

SAM Priority Code (CB09)
E - Non-Occupational

Course Cooperative Work Experience Education Status (CB10)
N - Is Not Part of a Cooperative Work Experience Education Program

Course Classification Status (CB11)
Y - Credit Course

Educational Assistance Class Instruction (Approved Special Class) (CB13)
N - The Course is Not an Approved Special Class

Course Prior to Transfer Level (CB21)
Y - Not Applicable

Course Noncredit Category (CB22)
Y - Credit Course

Funding Agency Category (CB23)
Y - Not Applicable (Funding Not Used)

Course Program Status (CB24)
1 - Program Applicable

General Education Status (CB25)
Y - Not Applicable

Support Course Status (CB26)
N - Course is not a support course

Field trips
Will be required

Faculty notes on field trips; include possible destinations or other pertinent information
Possible destinations include: Eastern Sierra, Mojave National Preserve, San Gabriel Mountains, and San Bernardino Mountains

Grading method
(L) Letter Graded

Alternate grading methods
(O) Student Option- Letter/Pass
(P) Pass/No Pass Grading

Does this course require an instructional materials fee?
No

Repeatable for Credit
No

Is this course part of a family?
No

Units and Hours

Carnegie Unit Override
No

In-Class

Lecture
Minimum Contact/In-Class Lecture Hours
52.5
Maximum Contact/In-Class Lecture Hours
52.5

Activity

Laboratory
Minimum Contact/In-Class Laboratory Hours
52.5
Maximum Contact/In-Class Laboratory Hours
52.5

Total in-Class

Total in-Class
Total Minimum Contact/In-Class Hours
105
Total Maximum Contact/In-Class Hours
105

Outside-of-Class

Internship/Cooperative Work Experience

Paid

Unpaid

Total Outside-of-Class

Total Outside-of-Class
Minimum Outside-of-Class Hours
105
Maximum Outside-of-Class Hours
105

Total Student Learning

Total Student Learning
Total Minimum Student Learning Hours
210
Total Maximum Student Learning Hours
210

Minimum Units (CB07)
4
Maximum Units (CB06)
4

Prerequisites
GEOL M02 and GEOL M02L or GEOL M03 and GEOL M03L

Advisories on Recommended Preparation
CHEM M12 or CHEM M01A or CHEM M01AH

Entrance Skills

Entrance Skills
GEOL M02 and GEOL M02L or GEOL M03 and GEOL M03L

Prerequisite Course Objectives
GEOL M02- describe and give examples of the interactions between the four basic components of the Earth as a global ecosystem - the atmosphere, hydrosphere, lithosphere, and biosphere.
GEOL M02- distinguish the Big Bang hypothesis from the solar nebula theory and explain current theories on stellar processes and how solar systems and planets form.
GEOL M02- apply the scientific method to solve geologic problems such as determining the age of the Earth; distinguishing data, observations, and evidence from interpretation.
GEOL M02- describe the Earth's internal layered structure, its composition and properties, and the methods used to study it; identify the internal processes that affect the lithosphere and plate tectonics.
GEOL M02- explain the theory of plate tectonics by describing the three types of plate boundaries, and the landforms and processes that occur at each type with reference to appropriate examples.
GEOL M02- locate the major lithospheric plates on a world map and correlate each type of plate boundary with the major landform that occurs there.

GEOL M02- relate plate tectonic processes to phenomena such as earthquakes and the formation and evolution of Earth's major features: oceans, continents, mountain ranges, and volcanoes.
GEOL M02- distinguish between elements, minerals, and rocks; define the properties of a mineral and recognize the importance of minerals as natural resources and in identifying rocks.
GEOL M02- classify and distinguish between igneous, sedimentary, and metamorphic rocks and describe how they are formed by internal and surface processes on the Earth and on other planets.
GEOL M02-determine the relative ages of rocks from an outcrop or a diagram by analyzing their relationships and combine their ages and processes of formation to construct the geologic history of an area.
GEOL M02- identify geologic structures and determine the forces that caused them.
GEOL M02- describe the processes and effects of physical and chemical weathering and mass movements.
GEOL M02- illustrate the hydrologic cycle and identify the variety of environments where erosion, sediment transport, and deposition occur.
GEOL M02- recognize and describe the interaction between human activities and the geologic environment; identify the major geologic hazards in the world and possible actions humans could take to avoid or mitigate property damage or loss of life.

Requisite Justification

Requisite Type
Prerequisite

Requisite
GEOL M02 and GEOL M02L or GEOL M03 and GEOL M03L

Requisite Description
Course in a sequence

Level of Scrutiny/Justification
Required by 4 year institution

Requisite Type
Recommended Preparation

Requisite
CHEM M12 or CHEM M01A or CHEM M01AH

Requisite Description
Course not in a sequence

Level of Scrutiny/Justification
Content review

Student Learning Outcomes (CSLOs)

	Upon satisfactory completion of the course, students will be able to:
1	evaluate the mineralogy of an igneous or metamorphic rock the student collected, using optical and geochemical techniques.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1	describe the symmetry of a mineral crystal, locate its crystallographic axes, and determine its crystal system and class.
2	describe crystal forms using Miller Indices.
3	describe types of bonds and determine coordination number for atoms in a mineral crystal.
4	explain the factors that control ionic substitution and apply them to explain compositional variability in specific minerals.
5	explain the basis of mineral classification and describe the mineral chemistry and crystal structures of all the nonsilicate and silicate mineral groups.

6	discuss the nature and origin of mineral ore deposits and relate their origin and occurrence to geologic processes and environments.
7	determine the composition and stability of mineral and melt phases based on analysis of phase equilibrium diagrams.
8	identify minerals in hand sample and thin section using physical and optical properties.
9	determine mineral occurrence by identifying and assessing mineral associations.
10	record accurate and reliable field notes of observed geologic data.

Course Content

Lecture/Course Content

- Crystallography (10%)
  - Crystal morphology and symmetry
  - Internal structure (crystallographic axes)
  - Miller Indices; twinning and crystal defects
  - Polymorphs, pseudomorphs, and polytypism
- Mineral chemistry and phase relations (20%)
  - Bonding, and coordination of atoms
  - Phase diagrams
  - Cation substitution
  - Zoning and exsolution
  - Plotting mineral composition on binary and ternary diagrams
- Analytical methods in mineralogy (10%)
  - Thin section analysis
  - Geochemical data analysis
  - X-ray diffraction
  - Scanning electron microprobe
- Silicate minerals (30%)
  - Melting processes
  - Crystallization processes (binary eutectic systems and fractional crystallization)
  - Seven silicate families
  - Rock-forming silicate mineral associations
  - Metamorphic mineralogy
- Nonsilicate mineral groups (15%)
  - Families
  - Common nonsilicate mineral associations
  - Connection to Earth system processes
- Mineral resources (15%)
  - Pegmatites and pegmatite minerals; origin of pegmatites, resource and gemstone minerals found in pegmatites
  - Mineral ores: occurrence and use of minerals, types of ore deposits

Laboratory or Activity Content

- Physical properties of minerals (7%)
- Crystallographic axes, crystal forms, Miller Indices (7%)
- Crystal symmetry: determining and recording symmetry of crystal models and crystal samples (14%)
- Field techniques of Mineralogy (14%)
- Silicate minerals: Identification of hand samples, occurrence and mineral associations (16%)
- Calculating mineral formulae from weight % oxides (7%)
- Interpreting binary eutectic phase diagrams (7%)
- Optical mineralogy: identification of common minerals in thin section, common mineral associations in igneous, metamorphic, and sedimentary rocks (7%)
- Lab and field study of pegmatite minerals (7%)
- Nonsilicate minerals: identification of hand samples, occurrence and mineral associations, ore deposits (14%)

Methods of Evaluation

Which of these methods will students use to demonstrate proficiency in the subject matter of this course? (Check all that apply):
Written expression

Problem solving exercises
Skills demonstrations

Methods of Evaluation may include, but are not limited to, the following typical classroom assessment techniques/required assignments (check as many as are deemed appropriate):

Essay exams
Laboratory activities
Laboratory reports
Objective exams
Problem-solving exams
Problem-solving homework
Quizzes
Skills demonstrations
Other (specify)
Classroom Discussion
Projects
Participation
Reports/Papers/Journals

Other

written lab exercises
sketches and notes in field notebooks
lab practical exams
group projects
research reports
field trip reports

Instructional Methodology

Specify the methods of instruction that may be employed in this course

Class activities
Collaborative group work
Field trips
Guest speakers
Laboratory activities
Lecture
Problem-solving examples
Other (specify)

Specify other method of instruction

hands-on practice using wooden crystal models and actual crystals
required field trips to museums, gem and mineral shows, mineral dealers, mining localities, and rock outcrops in southern California
demonstrations of field techniques in geology

Describe specific examples of the methods the instructor will use:

- demonstrate use of petrologic microscopes using guided laboratory exercises.
- think-pair-share exercises to derive concepts relating to mineral chemistry.
- present samples that are prototypical examples of crystal systems, mineral types, and twinning operations.

Representative Course Assignments

Writing Assignments

- write field notebook entries and field reports on trips to locations to practice field mineralogy.
- produce a summative conference-style poster presentation on the mineralogy of a region of choice.

Critical Thinking Assignments

- research the factors that control ionic substitution, then apply them to explain compositional variability in specific minerals.
- complete in-class exercises deriving key concepts. For example: plot the geothermal gradient on a peridotite phase diagram to understand the relationship between plate tectonics and melting.
- interpret binary eutectic phase diagrams to explain how to make silicate melts of varying composition.

Reading Assignments

- conduct a literature review on the mineralogy of a region, in support of applied mineralogy research project.
- read journal articles on updates in the fields of mineralogy and petrology.

Skills Demonstrations

- group project assessing the mineralogy of a sample collected by students, at outcrop, hand-sample, and thin section-scale.
- lab exercises assessing mineral mode from hand-samples and thin sections.

Outside Assignments

Representative Outside Assignments

- library or internet research on emerging topics in mineralogy.
- assignments or problems assessing mineral chemistry data and phase equilibria diagrams.
- homework practicing plotting data on binary and ternary diagrams.

Articulation

C-ID Descriptor Number
GEOL 280

Status
Approved

Equivalent Courses at 4 year institutions

University	Course ID	Course Title	Units
CSU Fresno	EES 12	Mineralogy	3
Cal Poly Pomona	GSC 2150 & 215L0	Mineralogy & Mineralogy Lab	2 & 1
CSU Northridge	GEOL 207 & 207L	Mineralogy and Mineralogy Lab	3 &1

District General Education

A. Natural Sciences

B. Social and Behavioral Sciences

C. Humanities

D. Language and Rationality

E. Health and Physical Education/Kinesiology

F. Ethnic Studies/Gender Studies

Course is CSU transferable
Yes

CSU Baccalaureate List effective term:
F1995

CSU GE-Breadth

Area A: English Language Communication and Critical Thinking

Area B: Scientific Inquiry and Quantitative Reasoning

Area C: Arts and Humanities

Area D: Social Sciences

Area E: Lifelong Learning and Self-Development

Area F: Ethnic Studies

CSU Graduation Requirement in U.S. History, Constitution and American Ideals:

UC TCA

UC TCA
Approved

IGETC

Area 1: English Communication

Area 2A: Mathematical Concepts & Quantitative Reasoning

Area 3: Arts and Humanities

Area 4: Social and Behavioral Sciences

Area 5: Physical and Biological Sciences

Area 6: Languages Other than English (LOTE)

Textbooks and Lab Manuals

Resource Type
Textbook

Description
Dutrow, Barbara and Cornelis Klein. *Manual of Mineral Science (Manual of Mineralogy)*. 23rd ed., John Wiley & Sons, 2007.

Resource Type
Textbook

Description
Perkins, Dexter. Mineralogy. E-book, University of North Dakota, 2020, https://opengeology.org/Mineralogy/. Accessed on 2 November 2021.

Resource Type
Textbook

Description
Nesse, William. *Introduction to Mineralogy*. 3rd ed., Oxford University Press, 2016.

Library Resources

Assignments requiring library resources
Research using the Library's print and online resources.

Sufficient Library Resources exist
Yes

Example of Assignments Requiring Library Resources
- Write reports on mineral occurrences and environments of formation.
- Conduct a literature review in support of a mineralogical analysis of the Earth material of a region.

Primary Minimum Qualification
EARTH SCIENCE

Review and Approval Dates

Department Chair
10/28/2021

Dean
10/28/2021

Technical Review
11/04/2021

Curriculum Committee
11/16/2021

DTRW-I
MM/DD/YYYY

Curriculum Committee
MM/DD/YYYY

Board
MM/DD/YYYY

CCCCO
MM/DD/YYYY

Control Number
CCC000435021

DOE/accreditation approval date
MM/DD/YYYY