

**Geology 205 – Earthquakes (4)
Course Outline**

GE B3

Prerequisites for GEOL 205 – None.

World-wide seismicity and plate tectonics. Seismic waves and their recording. Earth structure and composition. Intensity, magnitude, and energy. Major California faults and earthquakes. Paleoseismology, forecasting and prediction. Acceleration, resonance, and effects of ground shaking on structures. Earthquake safety. Tsunamis. 3 lectures, 1 recitation.

Learning Objectives and Criteria:

Upon completion of the course the student is expected to:

- a) Understand where earthquakes occur, where they do not, and why it is so.
- b) Understand the different types of earthquake faults and how to measure the strike and dip of a fault.
- c) Understand the theory of plate tectonics and the processes of sea-floor spreading, subduction and the role of transform faults.
- d) Understand the different types of seismic waves, and what factors determine their speed..
- e) Understand the basic principles regarding the seismometer.
- f) Understand seismograms and how earthquake ground motion is recorded.
- g) Understand how seismograms are "read."
- h) Use and understand travel-time curves.
- i) Understand how to determine the location (epicenter and hypocenter) of an earthquake from reading seismograms.
- j) Understand the different seismic ray paths throughout the body of the earth and how they are able to provide information about the deep interior.
- k) Understand seismic wave velocities and density with depth throughout the earth.
- l) Understand the primary structural divisions of the earth from crust to core.
- m) Understand the composition of the earth.
- n) Understand the earthquake process-elastic rebound, foreshocks and aftershocks.
- o) Understand earthquake intensity scales.
- p) Understand magnitude scales and how magnitude is determined from seismograms.
- q) Understand how energy is estimated.
- r) Know facts about the world's most damaging earthquakes.
- s) Understand the earthquake risk map for the United States and the most notable intraplate earthquakes.
- t) Know the names, locations, and senses of motion of California's major faults.
- u) Understand the seismicity of California, especially with regard to large and great historic earthquakes.
- v) Understand characteristics of some of the most damaging recent California earthquakes that may have affected some of the enrolled students.
- w) Understand aspects of the state of the art of earthquake forecasting.
- x) Understand the techniques and results of paleoseismological studies.
- y) Understand observable effects of strain buildup.
- z) Understand the theory of dilatancy and various observable precursory phenomena.

- aa) Understand the concept of ground acceleration.
- bb) Understand the relationships between force, acceleration, and building strength.
- cc) Understand the phenomenon of resonance and its application to structures, bodies of water, and the earth as a whole.
- dd) Understand what a tsunami is and how one can be triggered by an earthquake.

Text and References:

“Earthquakes: Science and Society” (2nd Edition) by David S. Brumbaugh

Content and Method:

Content: GEOL 205 will adhere to the following topics:

- I. Earthquakes as a Global Dynamic Process; where earthquakes occur; types of earthquakes; fault types; depth distributions.
- II. How earthquakes occur - Plate Tectonics; types of stress buildup; role of paleomagnetism in confirming the theory; earth dynamics.
- III. Seismic waves; Types; Seismometry: how earthquakes are recorded; Techniques to locate earthquakes from seismograms. Use of stereonet plots to determine earthquake focal mechanisms.
- IV. Body wave seismology; Seismic ray paths through the earth; Understanding travel-time curves.
- V. Earth structure and composition deduced from seismic wave studies; Velocity with depth; Density with depth; Phase changes; Composition of mantle and core.
- VI. Classification of earthquakes by "strength"; Magnitude; Intensity; Energy; Seismic moment; Use of magnitude scales in discriminating earthquakes from underground nuclear explosions (Comprehensive Test Ban Treaty).
- VII. Major historical earthquakes; global, US, California, SLO County.
Earthquake facts on the Internet.
- VIII. Earthquake risk and probabilistic forecasting. Current results from paleoseismology for assessment of earthquake history on major faults (e.g. San Andreas Fault).
- IX. Characteristics of recent significant CA earthquakes~Loma Prieta, Northridge
Effects of earthquakes; The effects of surface waves
Force, acceleration, weakening and collapse
- X. The phenomenon of resonance; Land and water; Tsunamis; Structures; Earthquake safety;
Minimizing the risk; Special Topics (depending on time)

Method:

GEOL 205 is a 4-unit course with 3 hours of lecture and 1 hour of recitation.

The addition of one hour per week to the course schedule makes possible more thorough recitations which can include detailed discussions of topics, videos where appropriate, quizzes, and some hands-on work with actual seismograms. Recitation time may also be used to introduce homework assignments that explore a topic in detail, e.g., a comparison of different magnitude calculations on real earthquake data.

Short in-class activities during lecture time may be used to encourage group work and immediate practice of a topic, e.g., plotting a focal mechanism.

Methods of Assessment:

The primary method of assessment will be in the form of examinations and homework assignments. There will also be short quizzes given prior to each exam. The exam style will be a combination of multiple choice, short written and computational answers, and essay.