**GEO 3010– Dynamic Earth (3 credits)**

**Lecture:** FASB XXX, 9:40-10:30 a.m., M, W

**Lab:** FASB XXX, 9:40-10:30 a.m., F

**Instructors:** *P1*: Lin, Koper, Thorne, Zhadnov; *P2*: Moore, Bartley, Jewell, Lippert

**Course Description:** This course will focus on the application of continuum mechanics to describe geologic processes and phenomena. We will cover a range of diverse topics spanning the inner and outer Earth including: elasticity, tectonics, heat flow, gravity, fluid dynamics, faulting, seismology, surface processes, and geological hazards. Students will learn fundamental physical and mathematical approaches to quantitatively describe, interpret, and predict a broad range of dynamic processes in Earth systems. Two lectures, one lab weekly.

**Required Pre-requisites:** Physics I (PHYS 2210)

**Recommended Co-requisites:** Calculus II (MATH 1220), Physics II (PHYS 2220)

**Required Text:** *Geodynamis 3rd ed., Turcotte and Schubert*. Additional / supplemental readings will be provided electronically via canvas.

## **1. Policies**

*Grades:* Final grades are based on following weights:

* Weekly problem sets from text (25%)
* Laboratory / workshop assignments (25%)
* Exam 1 (25%)
* Exam 2 (25%)

*Homework:* Problem sets will be assigned each week from the textbook or related reading and are due at the start of lab on Friday. Late assignments will be assessed a minimum penalty of 25% per week they are overdue.

*Labs:* Concepts introduced in lectures will be explored through interactive workshops where students work in teams to solve problems relating to dynamic Earth processes. Assignments are due after one week at the start of lab each Friday; late assignments will be assessed a penalty of 25% per week they are overdue.

*Exams:* Two exams will cover the first and second halves of the course, respectively. The final exam is not cumulative.

**2. Class Goals**

Students will be able to:

* *Need a concise list of learning goals here…*
* Understand physical laws underlying transfer and balance of energy, heat, force, and mass, and other kinetic processes and balances in Earth systems.
* Derive physical and mathematical approaches to describe, interpret, and predict a range of dynamic processes in Earth systems.
* Apply essential mathematical descriptions of dynamic phenomena to describe key processes in the interior of the Earth and on the Earth’s surface.
* …

**3. Lecture Schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Week** | **Lecture** | **Topic** | **Reading** |
| **1** |  | **Stress and strain** | **T&S …** |
|  | 1 | Global earth structure |  |
|  | 2 | Body and surface forces |  |
| **2** |  | **Elasticity and flexure** | **T&S …** |
|  | 3 | Linear elasticity |  |
|  | 4 | Plate flexure |  |
| **3** |  | **Global tectonics** | **T&S …** |
|  | 5 | Plate boundaries |  |
|  | 6 | Paleomagnetism and plate motion |  |
| **4** |  | **Heat** | **T&S …** |
|  | 7 | Fourier’s law, Advection and conduction |  |
|  | 8 | Transient heat conduction |  |
| **5** |  | **Gravity** | **T&S …** |
|  | 9 | Gravitational acceleration, reference gravity |  |
|  | 10 | Gravitational potential and the geoid |  |
| **6** |  | **Fluid mechanics 1** | **T&S …** |
|  | 11 | Constitutive relations, conservation equations |  |
|  | 12 | Dimensionless numbers, Stokes flow |  |
| **7** | **Exam 1** | | |
| **8** |  | **Fluid dynamics 2** | **T&S …** |
|  | 13 | Darcy’s law, hydraulic conductivity |  |
|  | 14 | Conservation equations in porous media |  |
| **9** |  | **Fracture and faulting** | **T&S …** |
|  | 15 | Fault types and associated stress and strain |  |
|  | 16 | State of stress in the crust |  |
| **10** |  | **Seismology** | **T&S …** |
|  | 17 | Seismic waves |  |
|  | 18 | Quantifying earthquakes |  |
| **11** |  | **Surface processes** | **Supplemental** |
|  | 19 | Advective equilibrium forms: river profiles |  |
|  | 20 | Diffusive equilibrium forms: hillslopes |  |
| **12** |  | **Landscape evolution** | **Supplemental** |
|  | 21 | Transient river profiles |  |
|  | 22 | Tectonics, climate, and erosion |  |
| **13** |  | **Geologic hazards** | **Supplemental** |
|  | 23 | Earthquake hazards |  |
|  | 24 | Mass movements |  |
| **14** | **Exam 2** | | |

**4. Lab Schedule**

|  |  |
| --- | --- |
| **Week** | **Lab Description** |
| 1 | Force balance – Isostasy, lithostatic stresses |
| 2 | Lithospheric flexure under Hawaii |
| 3 | Plate motions on a sphere (Euler angles, spherical geometry) |
| 4 | Cooling of oceanic lithosphere and ocean topography |
| 5 | Moment of inertia and the interior structure of the Earth |
| 6 | Lake Bonneville and the viscosity of the mantle |
| *7* | *No lab* |
| 8 | Aquifers and groundwater migration |
| 9 | Mohr-Coulomb failure, the Mohr circle and pore pressure |
| 10 | Interpreting seismograms |
| 11 | Exploring the convexity of hilltops |
| 12 | Reading the long river profile |
| 13 | Predicting landslide time of failure |
| *14* | *No lab* |

**5. Additional Notes**

**Statement Concerning Disabilities:** “The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations.”

(www.hr.utah.edu/oeo/ada/guide/faculty).

**Faculty and Student Responsibilities:** “All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in Article III of the code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know they are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee.”

“Faculty… must strive in the classroom to maintain a climate conducive to thinking and learning.” PPM 8-12.3, B.

“Students have a right to support and assistance from the University in maintaining a climate conducive to thinking and learning.” PPM 8-10, II. A.

**Addressing Sexual Misconduct:** Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity / expression) is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran’s status or genetic information. If you orsomeone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066.  For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776.  To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).