Syllabus
Geophysical Geodesy GPH 495/695

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Course Description:
The course will develop the basic concepts of geophysical geodesy, including the measurement and modeling of deformation of Earth from earthquakes, plate tectonics, volcanoes

Course Prerequisites: PHYS 180, MATH 182

Required texts, course materials:
No required text or materials

Course Objectives and/or learning outcomes:
Students will acquire knowledge of space geodetic technologies (e.g. GPS systems) and capabilities and will develop skills in building computer models that explain geodetic data in terms of solid Earth processes.

Description of Assignments: (exams, quizzes, projects, papers)
readings
problems sets.
1 mid-term
1 project

Grading Criteria: (percentage assignments, class participation contribute to final grade) Will plus/minus grading be used? What, if any, penalties will be imposed for late work? Will make-up exams be offered?

40% Problem sets
30% Mid-term
30% Projects

Course Calendar/Topics Outline:

I. THEORETICAL BASICS & TOOLKITS

week 1. Aug. 25,27: Geodetic Lexicon
- Class Logistics
- Pillars of geodesy - what we *won't* cover in this class
- Earth's gravity field and geoid

Datums, e.g. WGS84
latitude, longitude
What is height?

week 2. Sept. 1,3: Reference Systems and Transformations
X,Y,Z to N,E,U
Helmert 7-parameter transformations : Rotation, Translation, Scale
Vertical motions

Problem set #1

week 3-4. Sept. 8, 10, 15, 17: Strain, Stress & Elasticity
Tensors, 2 and 3 dimensions
Shear and bulk moduli

Problem sets #2 & #3

week 5.-6. Sept. 22, 24, 29, Oct 1: The GPS/GNSS system. Flavors of GPS.
Data content and structure.
Theory, model equations.
Properties of system, Orbits, Baselines, Triangles.
Methods and uses.

Problem set #4

mid-term Sept. 22.

II. CURRENT TOPICS IN GEODESY

week 7-8. Oct. 6, 8, 13: EarthScope-PBO/GGOS
Western US/Basin and Range tectonic deformation
Volcano Geodesy
Data types, access, use

Deadline: Graduate Student Projects must be defined.

Oct. 13 Field Trip to EarthScope Instrumentation

III. TECTONICS AND THE EARTHQUAKE CYCLE

week 8-9. Oct. 15, 20, Plate Motions and Plate Boundary Zones

Tectonics, rigidity of plates, Euler poles
Rates of motion, uncertainties
Distributed continental deformation, Continuum vs. Block representations
Stress in the lithosphere

Problem set #5

week 9-10. Oct. 22, 27, 29: The Earthquake Cycle – Interseismic Deformation
Observations, Geology, GPS, InSAR, Western U.S. perspective
Fault models
Savage equation
The San Andreas fault
Fault Creep
Asymmetric strain accumulation
Episodic Tremor and Slip

Problem set #6

week 11. Nov. 3, 5: The Earthquake Cycle – Coseismic Deformation
What happens during an Earthquake?
The Earthquake as seen with Seismology vs. Geodesy
Using data to infer the properties of an earthquake model
Okada functions.
Geodetic case studies:
The 1906 San Francisco Earthquake
The February 2008 Wells NV earthquake
2008 Mogul Swarm
The coming big ones (Cascadia, Southern California, etc.)
Periodic, Time predictable and slip predictable models.

week 12. Nov 10,12: The Earthquake Cycle - Post-seismic deformation
Observations
Transient vs. secular deformation
Rheologies: brittle vs. viscous-viscoelastic
Models, historical development

week 13. Nov. 17, 19, Interferometric Synthetic Aperture Radar
What is it? Strengths, Weaknesses
Coseismic deformations
Other Uses, e.g. subsidence

week 14. November 24, 26: Class presentations

week 15. Dec. 1, 3: Guest Lectures/What's the Professor been up to?
Tsunami Warning

week 16. Dec. 8, one day open.