FORMAT 1

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F626

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TRIAL COURSE OR NEW COURSE PROPOSAL

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SUBMITTED BY:

Prerequisite is intended to be the new Foundations of Geophysics course. 2/21/2012 JH

Department	Geology and Geophysics	College/School	CNSM
Prepared by	Carl Tape	Phone	907-474-5456

11. ***COURSE CLASSIFICATIONS:*** Undergraduate courses only, Consult with CLA Curriculum Council to apply S or H

18. ESTIMATED IMPACT

WHAT IMPACT, IF ANY, WILL THIS HAVE ON BUDGET, FACILITIES/SPACE, FACULTY, ETC.

This graduate-level will fulfill part of the teaching workload for new Geology & Geophysics faculty member Tape. Anticipated enrollment is 5-10 students; a small classroom in Elvey or Reichardt will be

19. LIBRARY COLLECTIONS

***APPROVALS:** Add additional signature lines as needed.*

[signature]	Date	9/8/11

Signature, Chair,
Program/Department of: Geology & Geophysics

[signature]	Date	9/30/11

Signature, Chair, College/School Curriculu[m] Council for: CNSM

[signature]	Date	Oct 5 2011

ATTACH COMPLETE SYLLABUS (as part of this application). Note: The guidelines are online:
http://www.uaf.edu/uafgov/facult

QUICK REFERENCE: Section 8 contains the calendar of topics and deadlines.

1. **Course information.** Course number is F626 (2/21/2012, JH).

GEOS F6XX	**Applied Seismology**, 3 credits, Spring 2014
Meeting times:	Tuesday and Thursday, 9:45–11:15
Meeting location:	TBA

[redacted]

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~~GEOS F431 or F631, or permission of instructor.~~

[redacted]

2. **Instructor information.**

[redacted]

Email:	`carltape@gi.alaska.edu`
Phone:	(907) 474-5456
Office hours:	Wednesday, 10:00–11:00, or by appointment

3. **Course materials.**

(a) **Textbooks.** All textbooks are available at the UAF library. The required textbooks are:

[redacted]

time-dependent, space-dependent elastic waves that originate at an earthquake source (for example, a fault slips) and propagate though the heterogeneous Earth structure, then are finally recorded as time series at seismometers on Earth's surface. Students will examine real seismic data and use computational models to estimate properties about earthquake source and Earth structure. Students will acquire practical, advanced seismological training that will prepare them for seismological investigations in the future, whether in academic, industry, or government jobs.

6. **Student learning outcomes.**

Upon completion of this course, students should be able to:

(a) Understand the relevant temporal, spatial, and magnitude scales in the field of

8. Course calendar (tentative).

	Day	Date	Topic	Reading Due[†]	Homework Due	Homework Assigned
1	Thurs	Jan-19	Seismology in 1911, 2011, and 2111	SW1	—	PS-1

9. **Course policies.**

(a) **Attendance:** All [redacted]

(b) **Tardiness:** Students are expected to arrive in class prior to the start of each class. If a student [redacted]

(c) **Participation and Preparation:**

(c) Overall course grades are based on the following criteria:

A	$x \geq 93$	excellent performance:
A–	$90 \leq x < 93$	[illegible]

[10] D. Komatitsch and J. Tromp, "Spectral-element simulations of global seismic wave

[redacted]

[11] D. Komatitsch and J. Tromp, "Spectral-element simulations of global seismic wave

[redacted]

Example homework

Problem Set 9: Forward problems and inverse problems

GEOS 607: Applied Seismology, Carl Tape

Assigned: March 22, 2012 — Due: March 29, 2012

Problem 1. Forward problem: PREM

The Preliminary Reference Earth Model, established in 1980, is a seminal work in seismology [redacted]

Write a function in Matlab `[x,y] = getellipse(m,theta)` that generates the proper output, and plot the result in Matlab for the model $\mathbf{m} = (0.1, 0.3, 0.5)$ using input angles $\boldsymbol{\theta} = (0, \ldots, 2\pi)$.

(Hint: For N linearly spaced angles, use `theta = linspace(0,2*pi,N)'`.)

Problem 3. Inverse problem: Using least squares to fit an ellipse to a set of data

From Problem 2, you should now have a plotting tool for an arbitrary ellipse model $\mathbf{m}$. For this problem, you do not need the parameter θ.

1. (X points) Write down in matrix form the least-squares problem $\mathbf{Gm} = \mathbf{d}$ whose unknown [redacted] form.

2. (X points) Using Matlab, implement your result in (a) and solve for $\mathbf{m}$ using the data

$$(x_i,\ y_i)\ :\ (3,3),\ (1,-2),\ (0,3),\ (-1,2),\ (-2,-2),\ (0,-4),\ (-2,0),\ (2,0).$$

[redacted]

References

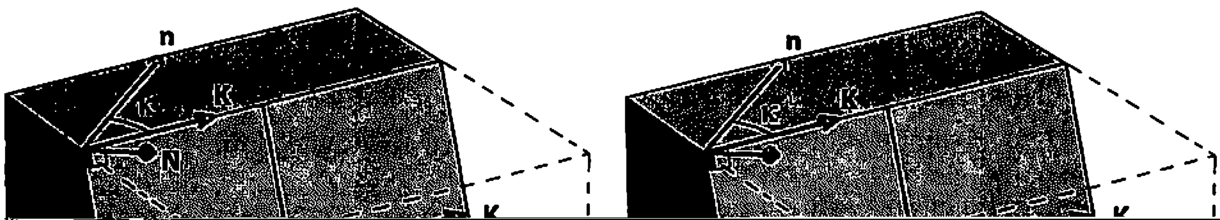
Dziewonski, A., and D. Anderson (1981), Preliminary reference Earth model, *Phys. Earth Planet. Inter.*, 25, 297–356,

Problem Set 10: Fault parameters and moment tensors

GEOS 607: Applied Seismology, Carl Tape

Assigned: March 29, 2012 — Due: April 5, 2012

$\kappa = 40°,\ \delta = 70°,\ \lambda = -120°$



Problem 1. Rotations in 2D and 3D

[redacted]

equations below are messy, containing dozens of terms of $\cos\alpha$, $\sin\phi$, etc. I am not asking for the full expressions; if you find yourself writing out long, messy equations, please stop!

1. (X points) Write down the 2×2 rotation matrix $\mathbf{R} = \mathbf{R}(\alpha)$ that rotates $\mathbf{r} = (x, y)$ by angle α in the positive (counter-clockwise) direction. What is the relationship between $\mathbf{R}(\alpha)$ and $\mathbf{R}(-\alpha)$? Show that for $\alpha = 90°$ your matrix will rotate $\mathbf{r} = (1, 0)$ to $\mathbf{r}' = (0, 1)$. If $\alpha = 60°$ and $\mathbf{r} = (1, 2)$, compute $\mathbf{r}'$; express your answer in exact (non-decimal) form.

2. (X points) Write down the 3×3 rotation matrix $\mathbf{R}_z = \mathbf{R}_z(\alpha)$ that rotates $\mathbf{r} = (x, y, z)$ by angle α in the positive (counter-clockwise) direction about the z-axis, $\hat{\mathbf{z}} = (0, 0, 1)$. Repeat for $\mathbf{R}_x(\alpha)$ and $\mathbf{R}_y(\alpha)$.

3. (X points) Write a function in Matlab that inputs a rotation angle α and an index for the axis ($k = 1, 2, 3$ for x, y, z), and then outputs the $\mathbf{R}_k(\alpha)$.

4. (X points) Using the matrix functions $\mathbf{R}_x(\alpha)$, $\mathbf{R}_y(\alpha)$, $\mathbf{R}_z(\alpha)$, derive an expression for the matrix, $\mathbf{U}(\mathbf{w}, \gamma)$, that rotates a vector $\mathbf{r}$ about the input vector $\mathbf{w}$ by angle γ. Let θ be the polar angle for $\mathbf{w}$ and ϕ be the azimuthal angle.

   Hint: What operations should be applied to $\mathbf{w}$?

5. (X points) Use your Matlab function for $\mathbf{R}_k(\alpha)$ to compute $\mathbf{U}(\mathbf{w}, \gamma)$ for input values of $\mathbf{w} = (X, X, X)$ and $\gamma = X°$. Check that $\mathbf{U}(-\mathbf{w}, -\gamma)$ gives the same result, and explain why this is the case.

[redacted]

4. (X points) [redacted]

this example.

5. (X points) There are many choices for computing the eigenvectors associated with a moment tensor. For this example, compute them using the following formulas:

$$
\begin{aligned}
\mathbf{p}_1 &= \frac{\mathbf{D}+\mathbf{N}}{|\mathbf{D}+\mathbf{N}|} \\
\mathbf{p}_3 &= \frac{\mathbf{D}-\mathbf{N}}{|\mathbf{D}-\mathbf{N}|} \\
\mathbf{p}_2 &= -\mathbf{p}_1 \times \mathbf{p}_3
\end{aligned}
$$

[redacted]

the upper right diagram.

[redacted]

Problem 3

(0 points) Approximately how many hours did you spend on this problem set? [illegible]

improvements here.