## TRIAL COURSE OR NEW COURSE PROPOSAL

**SUBMITTED BY:**
- **Department**: Geology and Geophysics
- **Prepared by**: Carl Tape
carltape@gi.alaska.edu
- **College/School**: CNSM
- **Phone**: 907-474-5456
- **Faculty Contact**: Carl Tape, x5456

### 1. ACTION DESIRED
- **(CHECK ONE):**
  - **Trial Course**: X
  - **New Course**: [ ]

### 2. COURSE IDENTIFICATION
- **Dept**: GEOS
- **Course #**: F694
- **No. of Credits**: 3

### 3. PROPOSED COURSE TITLE:
**Applied Seismology**

### 4. To be CROSS LISTED?
- **YES/NO**: NO
- **If yes, Dept**: [ ]
- **Course #**: [ ]

(Requires approval of both departments and deans involved. Add lines at end of form for such signatures.)

### 5. To be STACKED?
- **YES/NO**: NO
- **If yes, Dept**: [ ]
- **Course #**: [ ]

### 6. FREQUENCY OF OFFERING:
- **Spring, Even-numbered Years**

### 7. SEMESTER & YEAR OF FIRST OFFERING
- **AY2011-12** if approved by 3/1/2012; otherwise AY2012-13

### 8. COURSE FORMAT:
**NOTE**: Course hours may not be compressed into fewer than three days per credit. Any course compressed into fewer than six weeks must be approved by the college or school's curriculum council. Furthermore, any core course compressed to less than six weeks must be approved by the core review committee.

- **COURSE FORMAT**:
  - (check all that apply)
    - [ ] 1
    - [ ] 2
    - [ ] 3
    - [ ] 4
    - [ ] 5
    - [X] 6 weeks to full semester

- **OTHER FORMAT (specify)**
  - Mode of delivery (specify lecture, field trips, labs, etc)
  - Lecture, including in-class computational examples; short in-class discussions

### 9. CONTACT HOURS PER WEEK:
- **LECTURE hours/weeks**: 3
- **LAB hours/week**: 0
- **PRACTICUM hours/week**: 0

**Note**: # of credits are based on contact hours. 800 minutes of lecture=1 credit. 400 minutes of lab in a science course=1 credit. 1600 minutes in non-science lab=1 credit. 2400-4800 minutes of practicum=1 credit. 2400-8000 minutes of internship=1 credit. This must match with the syllabus. See [http://www.uaa.alaska.edu/ugsc/](http://www.uaa.alaska.edu/ugsc/) for more information on number of credits.

**OTHER HOURS (specify type)**

### 10. COMPLETE CATALOG DESCRIPTION including dept, number, title, credits, credit distribution, cross-listings and/or stacking (50 words or less if possible):
**GEOS 694** Applied Seismology
3 Credits Offered Spring Even-numbered Years
Presentation of modeling techniques for earthquakes and Earth structure using wave propagation algorithms and real seismic data. Covers several essential theories and algorithms for applications in seismology, as well as the basic tools needed for processing and using recorded seismograms. Topics include the seismic wavefield (body waves and surface waves), earthquake moment tensors, earthquake location, and seismic tomography. Assignments require familiarity with vector calculus, linear algebra, and computational tools such as Matlab. **Prerequisites:** MATH F202X and MATH F314 or permission of instructor. (3+0)
11. COURSE CLASSIFICATIONS: Undergraduate courses only. Consult with CLA Curriculum Council to apply S or H classification appropriately; otherwise leave fields blank.

H = Humanities

S = Social Sciences

Will this course be used to fulfill a requirement for the baccalaureate core? If YES, attach form.

YES: [ ] NO: [ ] X

If YES, check which core requirements it could be used to fulfill:

O = Oral Intensive, Format 6
W = Writing Intensive, Format 7
Natural Science, Format 8

12. COURSE REPEATABILITY:

Is this course repeatable for credit? YES [ ] NO [ ] X

Justification: Indicate why the course can be repeated (for example, the course follows a different theme each time).

How many times may the course be repeated for credit?

TIMES

If the course can be repeated for credit, what is the maximum number of credit hours that may be earned for this course?

CREDITS

If the course can be repeated with variable credit, what is the maximum number of credit hours that may be earned for this course?

CREDITS

13. GRADING SYSTEM: Specify only one. Note: Later changing the grading system for a course constitutes a Major Course Change.

LETT: [X] PASS/FAIL: [ ]

RESTRICTIONS ON ENROLLMENT (if any)

14. PREREQUISITES

MATH F202X

These will be required before the student is allowed to enroll in the course.

15. SPECIAL RESTRICTIONS, CONDITIONS

16. PROPOSED COURSE FEE

none

Has a memo been submitted through your dean to the Provost for fee approval?

Yes/No

17. PREVIOUS HISTORY

Has the course been offered as special topics or trial course previously?

Yes/No

If yes, give semester, year, course #, etc.: ______________

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 required.

19. LIBRARY COLLECTIONS

Have you contacted the library collection development officer (kjensen@alaska.edu, 474-6685) with regard to the adequacy of library/media collections, equipment, and services available for the proposed course? If so, give date of contact and resolution. If not, explain why not.

No [ ] Yes [X]
30. IMPACTS ON PROGRAMS/DEPTS

What programs/departments will be affected by this proposed action?
Include information on the Programs/Departments contacted (e.g., email, memo)

The Department of Geology and Geophysics will be affected by this proposal action in the sense that Applied Seismology will fulfill credit requirements for M.S. or Ph.D. geophysics students. In the revised geophysics curriculum, Applied Seismology is an elective course.

31. POSITIVE AND NEGATIVE IMPACTS

Please specify positive and negative impacts on other courses, programs and departments resulting from the proposed action.

The course will have a positive impact on the MS/PhD geophysics program (see “Justification” below).

The applied nature of the proposed course will provide valuable research training for students. The computational training would allow students to excel in several other courses with computational applications, such as the STAT 4XX and MATH 6XX courses listed in the proposed revisions to the geophysics curriculum.

The addition of a new graduate-level geophysics course could potentially diminish enrollment in other geophysics courses; however, students tend to take several more courses than the minimum requirements in geophysics MS/PhD. If a student decides to take only one seismology course, then Applied Seismology could diminish enrollment in Intermediate Seismology. C. Tape and D. Christensen have discussed how to make the two seismology courses complementary. We note that neither course is a prerequisite for the other.

JUSTIFICATION FOR ACTION REQUESTED

The purpose of the department and campus-wide curriculum committees is to scrutinize course change and new course applications to make sure that the quality of UAF education is not lowered as a result of the proposed change. Please address this in your response. This section needs to be self-explanatory. Use as much space as needed to fully justify the proposed course.

In the 1980s there were three seismology courses are UAF: Beginning Seismology, Intermediate Seismology, and Advanced Seismology. At present, only Intermediate Seismology is offered (taught by Doug Christensen). C. Tape was hired in 2010 in part to teach an advanced-level, applied seismology course, which is lacking from the current curriculum. The addition of the applied seismology course will strengthen training for seismology graduate students and also strengthen the MS/PhD concentration in Solid Earth Geophysics. In spring 2010, geophysics graduate students met multiple times to suggest changes to the MS/PhD geophysics program; an applied seismology course was one of their concrete recommendations.
APPROVALS: Add additional signature lines as needed.

<table>
<thead>
<tr>
<th>Signature, Chair, Program/Department of:</th>
<th>Date</th>
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<tbody>
<tr>
<td>Geology &amp; Geophysics</td>
<td>9/8/11</td>
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<tr>
<th>Signature, Chair, College/School Curriculum Council for:</th>
<th>Date</th>
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<tbody>
<tr>
<td>CNSm curr. council</td>
<td>9/8/11</td>
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<tr>
<th>Signature, Dean, College/School of:</th>
<th>Date</th>
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<tbody>
<tr>
<td>CNSm</td>
<td>Sept 9, 2011</td>
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</tbody>
</table>

Signature of Provost (if applicable)
Offerings above the level of approved programs must be approved in advance by the Provost.

ALL SIGNATURES MUST BE OBTAINED PRIOR TO SUBMISSION TO THE GOVERNANCE OFFICE

<table>
<thead>
<tr>
<th>Signature, Chair Faculty Senate Review Committee:</th>
<th>Date</th>
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</thead>
<tbody>
<tr>
<td>Curriculum Review GAAC Core Review SADAC</td>
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</table>

ADDITIONAL SIGNATURES: (As needed for cross-listing and/or stacking)

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<tr>
<th>Signature, Chair, Program/Department of:</th>
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</table>
QUICK REFERENCE: Section 8 contains the calendar of topics and deadlines.

1. Course information.
   
   GEOS F694  Applied Seismology, 3 credits, Spring 2012
   Meeting times:  Tuesday and Thursday, 9:45–11:15
   Meeting location:  TBA
   Prerequisites:  MATH F314 (Linear Algebra) or permission of instructor

2. Instructor information.
   
   Instructor:  Carl Tape
   Office:  413D Elvey (Geophysical Institute)
   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:


   One copy of [1] and [2] will be on reserve in Mather Library (within the IARC building); [1] is also available to be checked out from the UAF library as an e-book.

   I recommend the following textbooks for supplemental and more detailed information:

   seismology:  [3, 4, 5, 6, 7] (2009 paperback printing if available)
   continuum mechanics:  [8, 5]

   One copy of each of these books is on reserve at Mather library.

   (b) Journal articles assigned as reading will be available as PDFs through the course website on UAF Blackboard.

   (c) Students will need computers for their homework. General-use computers in UAF labs will be made available to students if needed.

   (d) Matlab will be the primary computational program for the course. Matlab is available via a UAF-wide license.

4. Course description.

   Seismology combines observational data (seismograms) with numerical modeling methods to obtain powerful inferences about earthquake sources and the three-dimensional structure of Earth’s interior. Applied Seismology will provide essential training for students’ interested in academic, industrial, or governmental careers in seismology.

   Catalog description: Presentation of modeling techniques for earthquakes and Earth structure using wave propagation algorithms and real seismic data. Covers several essential theories and algorithms for applications in seismology, as well as the basic tools needed for processing and using recorded seismograms. Topics include the seismic wavefield (body waves and surface waves), earthquake moment tensors, earthquake location, and seismic tomography. Assignments require familiarity with linear algebra and computational tools such as Matlab.

5. Course goals.

   We will explore the study of earthquakes and Earth’s interior structure using seismological theories and algorithms. The underlying physical phenomenon we will examine is the seismic wavefield: the
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 seismology.
(b) Describe the physical quantities that govern seismic wave propagation.
(c) Describe the seismic phases that arise in a regional or global layered Earth model.
(d) Describe the seismic moment tensor, the fundamental model of an earthquake source.
(e) Understand the basic framework of inverse problems within the context of seismology.
(f) Describe several different seismological tools that can be used to investigate an individual earthquake.
(g) Understand the connection between earthquakes, continental deformation, and plate tectonics.
(h) Understand the distinction between one-dimensional and three-dimensional Earth structure, and how this affects theory and algorithms in seismology.
(i) Read seismological journal articles and summarize the content efficiently.
(j) Write, improve, and run simple computational algorithms in Matlab.
(k) Plot and manipulate recorded seismograms.

7. **Instructional methods.**

(a) Assignments and grades (along with general course information and handouts) will be posted on Blackboard: classes.uaf.edu.
(b) Lectures will be the primary mode of instruction. Some lectures will be supplemented with computational examples to prepare students for homework problems.
(c) Each student is expected to lead one brief discussion and review of an assigned journal article.
### 8. Course calendar (tentative).

<table>
<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th>Topic</th>
<th>Reading Due†</th>
<th>Homework Due</th>
<th>Assigned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Thurs</td>
<td>Jan-19</td>
<td>Seismology in 1911, 2011, and 2111</td>
<td>SW1</td>
<td>—</td>
<td>PS-1</td>
</tr>
<tr>
<td>2 Tues</td>
<td>Jan-24</td>
<td>Seismograms, signal, noise, measurements</td>
<td>S11, SW6.6</td>
<td>PS-1</td>
<td>PS-2</td>
</tr>
<tr>
<td>3 Thurs</td>
<td>Jan-26</td>
<td>Basic analysis and processing of seismograms</td>
<td>DT2.6</td>
<td>PS-2</td>
<td>PS-3</td>
</tr>
<tr>
<td>4 Tues</td>
<td>Jan-31</td>
<td>Continuum mechanics</td>
<td>DT3, SW2, S2</td>
<td>PS-3</td>
<td>PS-4</td>
</tr>
<tr>
<td>5 Thurs</td>
<td>Feb-02</td>
<td>Equations of motion</td>
<td>SW2, S3</td>
<td>PS-5</td>
<td>PS-6</td>
</tr>
<tr>
<td>6 Tues</td>
<td>Feb-07</td>
<td>Solving the wave equation (3D)</td>
<td>DT2</td>
<td></td>
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<tr>
<td>7 Thurs</td>
<td>Feb-09</td>
<td>Solving the wave equation (1D and 2D)</td>
<td>SW2.9, S8.6, DT10.5</td>
<td>PS-4</td>
<td>PS-5</td>
</tr>
<tr>
<td>8 Tues</td>
<td>Feb-14</td>
<td>Normal modes: theory and observations</td>
<td>SW2.7-2.8, S8</td>
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<tr>
<td>9 Thurs</td>
<td>Feb-16</td>
<td>Surface waves: theory and observations</td>
<td>S4, SW3</td>
<td>PS-5</td>
<td>PS-6</td>
</tr>
<tr>
<td>10 Tues</td>
<td>Feb-21</td>
<td>Body waves, reflection, and transmission</td>
<td>SW4.3</td>
<td>PS-7</td>
<td>PS-8</td>
</tr>
<tr>
<td>11 Thurs</td>
<td>Feb-23</td>
<td>Waveform modeling</td>
<td>[9, 10, 11]</td>
<td></td>
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<tr>
<td>12 Tues</td>
<td>Feb-28</td>
<td>Wavefield modeling</td>
<td>[12, 13]</td>
<td>PS-6</td>
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<tr>
<td>13 Thurs</td>
<td>Mar-01</td>
<td>Finite-frequency sensitivity kernels</td>
<td>[14, 15]</td>
<td>final project</td>
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<tr>
<td>14 Tues</td>
<td>Mar-06</td>
<td>Ambient-noise tomography</td>
<td>[16], DT8.2</td>
<td>PS-7</td>
<td>PS-8</td>
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<tr>
<td>15 Thurs</td>
<td>Mar-08</td>
<td>Preliminary Reference Earth Model</td>
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<td>SPRING BREAK</td>
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<td></td>
<td>SPRING BREAK</td>
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<tr>
<td>16 Tues</td>
<td>Mar-20</td>
<td>Forward problems and inverse problems</td>
<td>SW4, S9</td>
<td>PS-8</td>
<td>PS-9</td>
</tr>
<tr>
<td>17 Thurs</td>
<td>Mar-22</td>
<td>Earthquake location</td>
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<tr>
<td>18 Tues</td>
<td>Mar-27</td>
<td>Seismic moment tensor</td>
<td>SW4.4, S9</td>
<td>PS-9</td>
<td>PS-10</td>
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<tr>
<td>19 Thurs</td>
<td>Mar-29</td>
<td>Finite source models</td>
<td>S9.8, WS4.5</td>
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<tr>
<td>20 Tues</td>
<td>Apr-03</td>
<td>Seismic tomography: global</td>
<td>S5, SW7.3</td>
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<tr>
<td>21 Thurs</td>
<td>Apr-05</td>
<td>Seismic tomography: crustal</td>
<td>SW3.2-3.3</td>
<td></td>
<td></td>
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<tr>
<td>22 Tues</td>
<td>Apr-10</td>
<td>Anisotropy and attenuation</td>
<td>SW3.6-3.7, S6.6,11.3</td>
<td>PS-11</td>
<td>final project</td>
</tr>
<tr>
<td>23 Thurs</td>
<td>Apr-12</td>
<td>Adjoint methods in seismology</td>
<td>[17, 18]</td>
<td></td>
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<tr>
<td>24 Tues</td>
<td>Apr-17</td>
<td>Finite source inversion</td>
<td>S9.8, SW4.5</td>
<td>final project</td>
<td></td>
</tr>
<tr>
<td>25 Thurs</td>
<td>Apr-19</td>
<td>Seismology, geodesy, and deformation</td>
<td>WS5</td>
<td>final project</td>
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<tr>
<td>26 Tues</td>
<td>Apr-24</td>
<td>Seismology of volcanoes</td>
<td>[19]</td>
<td>final project</td>
<td></td>
</tr>
<tr>
<td>27 Thurs</td>
<td>Apr-26</td>
<td>Seismology of glaciers</td>
<td>[20, 21]</td>
<td>final project</td>
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</tr>
<tr>
<td>28 Tues</td>
<td>May-01</td>
<td>Seismology in the oil industry</td>
<td>S7, WS3.3</td>
<td>final project</td>
<td></td>
</tr>
<tr>
<td>29 Thurs</td>
<td>May-03</td>
<td>Seismic monitoring for nuclear activity</td>
<td>[22]</td>
<td>final project</td>
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</tbody>
</table>

†SW = Ref. [1]; S = Ref. [2]; DT = Ref. [5]

### Some Important Dates:

- **First class:** Thursday January 19
- **Last day to add class:** Friday January 27
- **Last day to drop class:** Friday Feb 3
- **Last day for student- or faculty-initiated withdraw:** Friday March 23
- **Last class:** Thursday May 3
- **Final project report due:** Thursday May 3
- **Final project presentation:** TBD (May 7–10)
9. Course policies.

(a) Attendance: All students are expected to attend and participate in all classes.

(b) Tardiness: Students are expected to arrive in class prior to the start of each class. If a student does arrive late, they are expected to do so quietly and inform the instructor without disturbing the class.

(c) Participation and Preparation: Students are expected to come to class with assigned reading and other assignments completed as noted in the syllabus.

(d) Assignments:

i. All assignments are due at the start of class on the due date noted in the Syllabus.

ii. Late assignments will be accepted with a 20% penalty per day late; an assignment that is ≥ 5 days late will receive a zero.

iii. The lowest homework assignment will be dropped when computing the course grade.

Homework Tips: Please type or write neatly, keep the solutions in the order assigned and staple pages together. Include only relevant computer output in your solutions (a good approach is to cut and paste the relevant output for each problem into an editor such as MS Word or Latex). Also clearly circle or highlight important numbers in the output, and label them with the question number. I also suggest that you to include your Matlab code in your answers, both so that you can refer back to it for future assignments and so that I can identify where a mistake may have occurred. Display numerical answers with a reasonable number of significant figures and with units if the quantity is not dimensionless.

Homework scores are based on clarity of work, logical progression toward the solution, completeness of interpretation and summaries, and whether a correct solution was obtained. I encourage you to discuss homework problems with other students, however the work you turn in must be your own.

(e) Graded Assignments: Assignments will be graded for students within seven days of their receipt and returned at the end of the next class.

(f) Reporting Grades: All student grades, transcripts and tuition information are available online at www.naonline.alaska.edu.

(g) Consulting fellow students: Students are welcome to discuss with each other general strategies for particular homework problems. However, the write-up that is handed in—including any computer codes—must be individual work.

(h) Plagiarism: Students must acknowledge any sources of information—including fellow students—that influenced their homework assignments or final project. Any occurrence of plagiarism will result in a maximal penalty of forfeiture of all points for the particular homework assignment. If the plagiarism is between two students, then both students will potentially receive the penalty.

(i) All UA student academics and regulations are adhered to in this course. You may find these in the UAF Catalog.


(a) For students in the M.S. or Ph.D. program, you must receive a C or higher for this course for it to count toward your degree requirements.

(b) Grading is based on:

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Component</th>
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<tbody>
<tr>
<td>10%</td>
<td>Attendance and participation</td>
</tr>
<tr>
<td>60%</td>
<td>Homework Assignments</td>
</tr>
<tr>
<td>30%</td>
<td>Individual Final Project</td>
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</table>
(c) Overall course grades are based on the following criteria:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Score Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$x \geq 93$</td>
<td>excellent performance: student demonstrates deep understanding of the subject</td>
</tr>
<tr>
<td>A−</td>
<td>$90 \leq x &lt; 93$</td>
<td>strong performance: student demonstrates strong understanding of the subject, but the work lacks the depth and quality needed for an 'A'</td>
</tr>
<tr>
<td>B+</td>
<td>$87 \leq x &lt; 90$</td>
<td>average performance: student comprehends the essential material</td>
</tr>
<tr>
<td>B</td>
<td>$83 \leq x &lt; 87$</td>
<td>student demonstrates comprehension of some concepts</td>
</tr>
<tr>
<td>B−</td>
<td>$80 \leq x &lt; 83$</td>
<td>below average performance: student demonstrates comprehension of some concepts</td>
</tr>
<tr>
<td>C</td>
<td>$77 \leq x &lt; 80$</td>
<td>Failure to complete work with 60% quality</td>
</tr>
<tr>
<td>C−</td>
<td>$70 \leq x &lt; 73$</td>
<td>Failure to complete work with 60% quality</td>
</tr>
<tr>
<td>D</td>
<td>$60 \leq x &lt; 70$</td>
<td>Failure to complete work with 60% quality</td>
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<tr>
<td>F</td>
<td>$x &lt; 60$</td>
<td>Failure to complete work with 60% quality</td>
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</table>

(d) Final Project. The final project will constitute 30% of the course grade. The project will involve independent research into one aspect of seismology. It will require some computation and will be presented in the form of a written report, due on the last lecture class of the semester, and a short in-class presentation during the scheduled final exam. The report will be written in manuscript-submission style and format, using the guidelines for Geophysical Research Letters. Additional details, including project suggestions, will be provided by the instructor midway through the course.


The instructor is available by appointment for additional assistance outside session hours. UAF has many student support programs, including the Math Hotline (1-866-UAF-MATH; 1-866-6284) and the Math and Stat Lab in Chapman building (see www.uaf.edu/dms/mathlab/ for hours and details).


The Office of Disability Services implements the Americans with Disabilities Act (ADA), and it ensures that UAF students have equal access to the campus and course materials. The Geophysics Program will work with the Office of Disability Services (203 WHIT, 474-7043) to provide reasonable accommodation to students with disabilities.

13. References listed in syllabus.


