FORMAT 2

Submit originals (including syllabus) and one copy and electronic copy to the **Faculty Senate Office**
See http://www.uaf.edu/uafgov/faculty-senate/curriculum/course-degree-procedures-/ for a complete description of the rules governing curriculum & course changes.

CHANGE COURSE (MAJOR) and DROP COURSE PROPOSAL

Attach a syllabus, except if dropping a course.

SUBMITTED BY:

Department	**Geosciences**	**College/School**	**CNSM**
Prepared by	**Carl Tape**	**Phone**	**X5456**
Email Contact	**ctape[a]alaska.edu**	**Faculty Contact**	**(same)**

1. COURSE IDENTIFICATION: As the course now exists.

Dept	**GEOS**	Course #	**627**	No. of Credits	**3**

COURSE TITLE	**Inverse Problems and Parameter Estimation**

2. ACTION DESIRED: √ Check the changes to be made to the existing course.

Change Course	**X**	If Change, indicate below what is changing.	Drop Course	

NUMBER		**TITLE**		**DESCRIPTION**	
PREREQUISITES*				***FREQUENCY OF OFFERING***	

*Prerequisites will be *required* before a student is allowed to enroll in the course.

CREDITS (including credit distribution)		**3 (2+3)**		***COURSE CLASSIFICATION***	
ADD A STACKED LEVEL *(400/600)* *Include syllabi.*		Dept.		Course #	

How will the two course levels differ from each other? How will each be taught at the appropriate level?:	

Stacked course applications are reviewed by the (Undergraduate) Curricular Review Committee and by the Graduate Academic and Advising Committee. Creating two different syllabi—undergraduate and graduate versions—will help emphasize the different qualities of what are supposed to be two different courses. The committees will determine: 1) whether the two versions are sufficiently different (i.e. is there undergraduate and graduate level content being offered); 2) are undergraduates being overtaxed?; 3) are graduate students being undertaxed? In this context, the committees are looking out for the interests of the students taking the course. Typically, if either committee has qualms, they both do. More info online – see URL at top of this page.

ADD NEW CROSS-LISTING	**X**	Dept. & No.	PHYS 625	Requires approval of both departments and deans involved. Add lines at end of form for additional signatures.
STOP EXISTING CROSS-LISTING		Dept. & No.		Requires notification of other department(s) and mutual agreement. Attach copy of email or memo.
OTHER (specify)				

3. 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 **and** the appropriate Faculty Senate curriculum committee. 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 all that apply)	
Mode of delivery (specify lecture, field trips, labs, etc.)	**1. lectures** **2. computational laboratory sessions**

4. COURSE CLASSIFICATIONS: (undergraduate courses only. Use approved criteria found in Chapter 12 of the curriculum manual. If justification is needed, attach separate sheet.)

H = Humanities		S = Social Sciences	

Will this course be used to fulfill a requirement for the baccalaureate core?	YES		NO	X

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

O = Oral Intensive, *Format 6 also submitted		W = Writing Intensive, *Format 7 submitted		X = Baccalaureate Core	

4.A ***Is course content related to northern, arctic or circumpolar studies? If yes, a "snowflake" symbol will be added in the printed Catalog, and flagged in Banner.***

YES		NO	X

5. 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 with variable credit, what is the maximum number of credit hours that may be earned for this course?		CREDITS

6. <u>COMPLETE</u> CATALOG DESCRIPTION including dept., number, title, credits, credit distribution, cross-listings and/or stacking, clearly showing the changes you want made. (<u>Underline new wording</u> ~~strike through old wording~~ and use complete catalog format including dept., number, title, credits and cross-listed and stacked.)

Example of a <u>complete</u> description:

PS F450 Comparative ~~Aboriginal~~ <u>Indigenous</u> Rights and Policies (s)
3 Credits
Offered As Demand Warrants
~~Case study~~ <u>Comparative</u> approach ~~in assessing Aboriginal~~ <u>to analyzing Indigenous</u> rights and policies in different nation-state systems. ~~Seven Aboriginal situations~~ <u>Multiple countries and specific policy developments</u> examined for factors promoting or limiting self-determination. Prerequisites: Upper division standing or permission of instructor. (Cross-listed with ANS F450.) (3+0)

GEOS F627 Inverse Problems and Parameter Estimation
3 Credits
Offered Spring Odd-numbered Years
~~A forward problem uses a model to make predictions; an~~ <u>An</u> inverse problem uses observations to infer properties of an unknown physical model. One example ~~of an inverse problem is how to use~~ <u>is how</u> seismometer recordings <u>can be</u> used to infer the location of an earthquake. This course covers inverse theory and methods for solving inverse problems, including numerous examples arising in the natural sciences. Topics include linear regression, method of least squares, discrete ill-posed inverse problems, estimation of uncertainties, iterative optimization, and probabilistic (Bayesian) and sampling approaches. Assignments <u>and computational laboratory exercises</u> require familiarity with linear algebra and computational tools such as Matlab. Prerequisites: MATH F202X and MATH F314<u>;</u> or permission of instructor. <u>Cross-listed with PHYS 625.</u> (~~3~~2+~~0~~3)

7. COMPLETE CATALOG DESCRIPTION AS IT SHOULD APPEAR AFTER ALL CHANGES ARE MADE:

GEOS F627 Inverse Problems and Parameter Estimation
3 Credits
Offered Spring Odd-numbered Years
An inverse problem uses observations to infer properties of an unknown physical model. One example is how seismometer recordings can be used to infer the location of an earthquake. This course covers inverse theory and methods for solving inverse problems, including numerous examples arising in the natural sciences. Topics include linear regression, method of least squares, discrete ill-posed inverse problems, estimation of uncertainties, iterative optimization, and probabilistic (Bayesian) and sampling approaches. Assignments and computational laboratory exercises require familiarity with linear algebra and computational

tools such as Matlab. Prerequisites: MATH F202X and MATH F314; or permission of instructor. Cross-listed with PHYS F625. (2+3)

8. GRADING SYSTEM: ***Specify only one.***

LETTER:	X	PASS/FAIL:	

9. ESTIMATED IMPACT

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

10. LIBRARY COLLECTIONS

Have you contacted the library collection development officer (kljensen@alaska.edu, 474-6695) 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	This is from the Format 2 paperwork for the original course: "I contacted Karan Jensen and Flora Grabowska on 9-11-2011 via email to ask about the procedures for e-books and reserve. As indicated in the syllabus, all five textbooks will be available on reserve at Mather; two are available as ebooks; one is available as a free pdf. I received an email response from Flora, and I attended a new-faculty workshop on e-books led by Karen, who I met in person."

11. 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 change means that Inverse Problems and Parameter Estimation (GEOS 627) will require computational labs from now onwards. This is a major undertaking for teaching the class, whether it is I or someone else. But this is what is needed to train graduate students in inverse problems, and this is how the class is currently being taught.

12. POSITIVE AND NEGATIVE IMPACTS

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

I do not see impacts on other courses, programs, or departments.

ADDENDUM ON February 4, 2015
I do not see any negative impacts on other courses, programs, or departments.

With the 2+3 designation, the course introduces a computational lab. This better reflects how the course is actually taught. And it demonstrates that students in this class will receive lab-based computational training toward solving statistical problems in sciences.

A second positive impact is that the class will be cross-listed within the physics department. This will provide a more direct opportunity for physics students to learn the materials within the course; furthermore, MS physics students can receive credit toward their degree (since it is a 600-level physics course). Given the relatively small size of UAF, I think it is helpful that classes such as Inverse Problems are aimed at multiple departments, rather than just one.

13. 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. If you ask for a change in # of credits, explain why; are you increasing the amount of material covered in the class? If you drop a prerequisite, is it because the material is covered elsewhere? If course is changing to stacked (400/600), explain higher level of effort and performance required on part of students earning graduate credit. Use as much space as needed to fully justify the proposed change and explain what has been done to ensure that the quality of the course is not compromised as a result.

I taught Inverse Problems and Parameter Estimation for the first time in 2013, when it attracted a surprisingly large number (12) of graduate students from disciplines such as chemistry, seismology, ice physics, and remote sensing. Based on the design of the course and the feedback from the students (to each problem set and within the 2013 course evaluations), I have come to realize that a formal lab is needed in order to (1) reflect the nature of the course, which has regular computational labs (each student is given a Linux account) and (2) provide the necessary in-lab technical training needed for the homework problems. The course is centered on 8 challenging problems sets, each of which has a separate computational lab exercises associated with it. Furthermore, each student is required to do a research project that involves a computational application of an inverse problem of their choice. I ask the students how many hours each problem set takes, and the average is about 15 hours. I expect that the introduction of formal labs will give the students targeted training for the problem sets, thereby reducing the number of hours out of lab/class needed for the homework. Understanding inverse problems requires considerable hands-on experience with computer programs; in fact our textbook comes with a full set of Matlab codes to reproduce the examples within the book. I do not believe that this understanding can be achieved without the computational lab sessions. Therefore I am seeking to formally introduce computational lab sessions with a change from (3+0) to (2+3), still 3 credits.

I encourage the reviewer of this proposed course change to examine the course content (problem sets and labs) that are posted on this website:
http://www.giseis.alaska.edu/input/carl/teaching/inverse/inv.html
This helps to convey the importance of the computational labs within the course. (Note: not all labs are posted.)

The syllabus submitted with this paperwork is written for the (2+3) format that hopefully will be approved for the next time the class is offered, in Spring 2017. In Spring 2015, the class will be officially scheduled as (3+0), with two 1.5-hour lectures. But, as previously, it will be taught with one of the two lectures resembling a computational lab setting.

Please feel free to contact me directly if you have any questions (ctape@alaska.edu).

ADDENDUM ON JANUARY 21, 2015.
The physics department would like to cross-list GEOS 627 and PHYS 625, and I am supportive of this change. The concepts within GEOS 627 are relevant to physics graduate students, so having it cross-listed would make this more apparent. Furthermore, by making it a physics course, the MS physics students can get credit for this course toward their degree, which requires "approved PHYS F600-level courses".

APPROVALS: ***(Additional signature blocks may be added as necessary.)*** SEE ATTACHED SIGNATURES

	Date	
Signature, Chair, Program/Department of:		

	Date	
Signature, Chair, College/School Curriculum Council for:		

	Date	
Signature, Dean, College/School of:		

Offerings above the level of approved programs must be approved in advance by the Provost:

	Date	
Signature of Provost (if applicable)		

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

	Date	
Signature, Chair Faculty Senate Review Committee: ___Curriculum Review ___GAAC		

I encourage the reviewer of this proposed course change to examine the course content (problem sets and labs) that are posted on this website:
http://www.giseis.alaska.edu/input/carl/teaching/inverse/inv.html
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Please feel free to contact me directly if you have any questions (carltape@gi.alaska.edu).

APPROVALS: (Additional signature blocks may be added as necessary.)

Signature, Chair, Program/Department of: GEOSCIENCES	Date	9-18-14
Signature, Chair, College/School Curriculum Council for: CNSM	Date	9-25-14
Signature, Dean, College/School of: CNSM	Date	9/26/14

Offerings above the level of approved programs must be approved in advance by the Provost:

Signature of Provost (if applicable)	Date	

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

Signature, Chair Faculty Senate Review Committee: ___Curriculum Review ___GAAC ___Core Review ___SADAC	Date	

ADDITIONAL SIGNATURES: (As needed for cross-listing and/or stacking; add more blocks as necessary.)

Signature, Chair, Program/Department of:	Date	
Signature, Chair, College/School Curriculum Council for:	Date	
Signature, Dean, College/School of:	Date	

Note: If removing a cross-listing, attach copy of email or memo to indicate mutual agreement of this action by the affected department(s). If degree programs are affected, a Format 5 program change form must also be submitted.

ADDITIONAL SIGNATURES ON NEXT PAGES

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.

This was at the request of the Geology and Geophysics to be able to attract more students to the course. And Physics is in agreement.

APPROVALS: Add additional signature lines as needed.

	Date	25 June 2014

Signature, Chair, Program/Department of:	**Dr.CURT SZUBERLA** **PHYSICS**

	Date	

Signature, Chair, College/School Curriculum Council for:	**CNSM**

	Date	

Signature, Dean, College/School of:	**DR. PAUL LAYER** **CNSM**

Offerings above the level of approved programs must be approved in advance by the Provost.

	Date	

Signature of Provost (if above level of approved programs)

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

	Date	

Signature, Chair
Faculty Senate Review Committee: ___Curriculum Review ___GAAC
___Core Review ___SADAC

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

	Date	

Signature, Chair, Program/Department of:	~~PAUL MCCARTY~~ Sarah Fowell, Co-Chair **GEOLOGY/GEOPHYSICS**

	Date	9-23-14

Signature, Chair, College/School Curriculum Council for:	**CNSM**

	Date	9/23/14

Signature, Dean, College/School of:	**DR. PAUL LAYER** **CNSM**

ATTACH COMPLETE SYLLABUS (as part of this application). This list is online at:
http://www.uaf.edu/uafgov/faculty-senate/curriculum/course-degree-procedures-/uaf-syllabus-requirements/
The Faculty Senate curriculum committees will review the syllabus to ensure that each of the items listed below are included. If items are missing or unclear, the proposed course (or changes to it) may be denied.

Syllabus CHECKLIST for all UAF courses
During the first week of class, instructors will distribute a course syllabus. Although modifications may be made throughout the semester, this document will contain the following information (as applicable to the discipline):

1. Course information:
θTitle, θ number, θcredits, θprerequisites, θ location, θ meeting time

(make sure that contact hours are in line with credits).

2. Instructor (and if applicable, Teaching Assistant) information:

θ Name, θ office location, θ office hours, θ telephone, θ email address.

3. Course readings/materials:

θ Course textbook title, θ author, θ edition/publisher.

θ Supplementary readings (indicate whether θ required or θ recommended) and

θ any supplies required.

4. Course description:

θ Content of the course and how it fits into the broader curriculum;

θ Expected proficiencies required to undertake the course, if applicable.

θ Inclusion of catalog description is *strongly* recommended, and

θ Description in syllabus must be consistent with catalog course description.

5. θ Course Goals (general), and (see #6)

6. θ Student Learning Outcomes (more specific)

7. Instructional methods:

θ Describe the teaching techniques (eg: lecture, case study, small group discussion, private instruction, studio instruction, values clarification, games, journal writing, use of Blackboard, audio/video conferencing, etc.).

8. Course calendar:

θ A schedule of class topics and assignments must be included. Be specific so that it is clear that the instructor has thought this through and will not be making it up on the fly (e.g. it is not adequate to say "lab". Instead, give each lab a title that describes its content). You may call the outline Tentative or Work in Progress to allow for modifications during the semester.

9. Course policies:

θ Specify course rules, including your policies on attendance, tardiness, class participation, make-up exams, and plagiarism/academic integrity.

10. Evaluation:

θ Specify how students will be evaluated, θ what factors will be included, θ their relative value, and θ how they will be tabulated into grades (on a curve, absolute scores, etc.) θ Publicize UAF regulations with regard to the grades of "C" and below as applicable to this course. (Not required in the syllabus, but is a convenient way to publicize this.) Link to PDF summary of grading policy for "C": http://www.uaf.edu/files/uafgov/Info-to-Publicize-C_Grading-Policy-UPDATED-May-2013.pdf

11. Support Services:

θ Describe the student support services such as tutoring (local and/or regional) appropriate for the course.

12. Disabilities Services: Note that the phone# and location have been **updated.** http://www.uaf.edu/disability/ The Office of Disability Services implements the Americans with Disabilities Act (ADA), and ensures that UAF students have equal access to the campus and course materials.

θ State that you will work with the Office of Disabilities Services (208 WHITAKER BLDG, 474-5655)to provide reasonable accommodation to students with disabilities.

5/21/2013

Cross-listed as PHYS F625

UNIVERSITY OF ALASKA FAIRBANKS

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

Last compiled: August 4, 2014

1. **Course information.**

GEOS F627	**Inverse Problems and Parameter Estimation**, 3 credits (2+3), Spring 2017
Lab time:	Tuesday, 9:45–12:45
Lecture time:	Thursday, 9:45–11:45
Meeting location:	TBD
Prerequisites:	MATH 202 (Calculus III) and MATH 314 (Linear Algebra)

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.** The required (R) and supplemental (S) textbooks are listed in the following table; bibliographic details are listed at the end of this syllabus. "Software" lists the software (if any) used in examples within each book. The Geophysical Institute's Mather library is located on the gound floor of the IARC/Akasofu building.

Textbook	R	S	Software	Availability			
				UAF bookstore	Mather reserve	PDF	UAF e-book
[1] Aster	X		Matlab		X		X
[2] Tarantola	X		none		X	X	
[3] Menke		X	Matlab		X		X
[4] Parker		X	none		X		
[5] Weisberg		X	R				X

[2] can be downloaded as a pdf from Tarantoa's webpage. However, he writes: "Here are the rules: i) you are invited to download, view, and print the books; ii) if you work in a commercial company, or in a rich institution (like a university in the developed world), and your plan is to use one of the books from time to time, please purchase it (links below)."

(b) Journal articles (and PDF books) 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.**

An inverse problem is a procedure by which observations or measurements are used with quantitative models to gain inferences about some underlying physical quantity or system. Inverse problems occur in all fields of natural sciences — even something as simple as fitting a line to scattered data is an inverse problem. This course will provide a general framework, as well as general computational

algorithms, for approaching inverse problems. The training should benefit all students in natural sciences who are seeking inferences from data.

Catalog description: An inverse problem uses observations to infer properties of an unknown physical model. One example is how seismometer recordings can be used to infer the location of an earthquake. This course covers inverse theory and methods for solving inverse problems, including numerous examples arising in the natural sciences. Topics include linear regression, method of least squares, discrete ill-posed inverse problems, estimation of uncertainties, iterative optimization, and probabilistic (Bayesian) and sampling approaches. Assignments and computational laboratory exercises require familiarity with linear algebra and computational tools such as Matlab.

5. **Course goals.**

We will explore the ubiquitous realm of inverse problems in Earth sciences: how to use observations to make inferences about underlying physical quantities or processes. Our ultimate goal is to be able to recognize the fundamental components of an inverse problem — measurements, model parameters, misfit function, forward model — then to pose an approach to solving the problem, then solve the problem with computational algorithms. Concepts of inverse theory and parameter estimation are fundamental to all observational scientists, which includes most students in the natural sciences. During this course students should acquire both a philosphical and scientific appreciation for inverse methods and problems.

6. **Student learning outcomes.**

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

(a) Articulate the basic features of forward problems and inverse problems.

(b) Describe numerous examples of inverse problems and the basic components of each problem.

(c) Set up and solve an inverse problem using the least squares approach.

(d) Obtain a linear model from a set of data using multiple linear regression.

(e) Understand and use data covariances and model covariances within an inverse problem.

(f) Describe singular value decomposition and its relevance to inverse methods.

(g) Explain and implement a regularization technique.

(h) Explain the importance of sampling algorithms for estimating uncertainties of model parameters.

(i) Pose and answer statistical questions from a particular set of model samples.

(j) Describe probabilistic approaches to inverse problems.

(k) Write, improve, and run computational algorithms in Matlab.

7. **Instructional methods.**

(a) Assignments and handouts will be posted on Blackboard: `classes.uaf.edu`.

(b) Lectures (2 hours per week) will be the primary mode of instruction.

(c) Computational laboratory sessions (3 hours per week) include dedicated exercises that provide technical training for homework problems.

8. **Course calendar (tentative).**

Day	Date	Topic	Reading Due†	Homework Due	Homework Assigned
Thurs		overview of inverse problems	A1	—	HW-1
Tues		review of linear algebra	A-A, `matrix_fun.pdf`		
Tues		LAB: Linux and Matlab			
Thurs		review of linear algebra	A-A	HW-1	HW-2
Tues		Taylor series and least squares	`taylor.pdf`		
Tues		LAB: least squares (`lab_linefit.pdf`)			
Thurs		Taylor series and least squares	T3, A-C	HW-2	HW-3
Tues		Taylor series and least squares			
Tues		LAB: sampling $\sigma_M(\mathbf{m})$ (`lab_epi.pdf`)	T2, T7.1		
Thurs		probability density	A-B, `tarantola.pdf`		
Tues		covariance	A-B, `tarantola.pdf`		
Tues		LAB: sampling a N-D $\sigma_M(\mathbf{m})$			
Thurs		sampling methods		HW-3	HW-4
Tues		generalized least squares	T3, `tarantola.pdf`		
Tues		LAB: Newton method (`lab_newton.pdf`)	T6.22		
Thurs		generalized least squares	T3, `tarantola.pdf`	HW-4	HW-5
Tues		generalized least squares			
Tues		LAB: iterative methods (`lab_iter.pdf`)	A6, A9		
Thurs		linear regression	A2	HW-5	HW-6
Tues		linear regression	A2		final project
Tues		LAB: Aster Ch. 2			
Thurs		linear regression	A2	HW-6	HW-7
Tues		SPRING BREAK			
Thurs		SPRING BREAK			
Tues		InSAR and parameter estimation: volcanoes	`lab_mogi.pdf`		
Tues		LAB: Mogi source from InSAR (`lab_mogi.pdf`)			
Thurs		InSAR and parameter estimation: earthquakes		HW-7	HW-8
Tues		singular value decomposition	A3		
Tues		LAB: Aster Ch. 3			
Thurs		singular value decomposition	A3		
Tues		singular value decomposition	A3		
Tues		LAB: truncated SVD			
Thurs		resolution analysis	A3	HW-8	
Tues		Tikhonov regularization	A4		final project
Tues		LAB: Aster Ch. 4			
Thurs		Tikhonov regularization	A4		final project
Tues		principal component analysis	notes		final project
Tues		LAB: principal component analysis			
Thurs		discretizing problems with basis functions	A5		final project
Tues		classical inverse problems			
Tues		LAB: final project			
Thurs		classical inverse problems			final project
Tues		final presentations			
Tues		LAB: final project			
Thurs		final presentations			
Fri				final report	

†A = Ref. [1], T = Ref. [2]

Some Important Dates:

First class:	Thursday	January 15
Last day to add class:	Friday	January 23
Last day to drop class:	Friday	January 30
Last day for student- or faculty-initiated withdraw:	Friday	March 13
Last class:	Thursday	April 30
Final project report:	Friday	May 1
Final project presentation:	Tuesday	April 28
	Thursday	April 30

9. **Course policies.**

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

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

   (c) **Assignments**:

      i. All assignments are due **at the start of class** on the due date.

      ii. Late assignments will be accepted with a 10% penalty per day late, up to five days late; an assignment that is ≥ 5 days late will receive a zero. (An assignment that is "one day late" would be handed in less than 24 hours after the start time of class on the due date.)

      iii. No digital submission of assigments will be accepted.

   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 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 the most relevant portions of your Matlab code in your answers, especially in cases when you think your code is not working. 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.

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

   (e) **Reporting Grades**: All student grades, transcripts and tuition information are available on line at `www.uaonline.alaska.edu`.

   (f) **Consulting fellow students**: Students are permitted 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.

   (g) **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 forfeiture of all points for the particular homework assignment. If the plagiarism is between two students, then both students will potentially receive the penalty.

   (h) All UA student academics and regulations are adhered to in this course. You may find these in the UAF catalog (section "Academics and Regulations").

10. **Evaluation.**

(a) Grading is based on:

80%	Homework assignments
20%	Individual final project

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

A	$x \geq 93$	excellent performance:
A–	$90 \leq x < 93$	student demonstrates deep understanding of the subject
B+	$87 \leq x < 90$	strong performance:
B	$83 \leq x < 87$	student demonstrates strong understanding of the subject,
B–	$80 \leq x < 83$	but the work lacks the depth and quality needed for an 'A'
C+	$77 \leq x < 80$	mediocre performance:
C	$73 \leq x < 77$	student demonstrates comprehension of some
C–	$70 \leq x < 73$	essential concepts only
D	$60 \leq x < 70$	poor performance:
		student demonstrates poor comprehension of concepts
F	$x < 60$	Failure to complete work with 60% quality

(c) **Final Project.** The final project will constitute 20% of the course grade. The project will involve independent research into an inverse problem of the student's choice. 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. Additional details, including project suggestions, will be provided by the instructor midway through the course.

11. **Support Services.**

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).

12. **Disabilities Services.**

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 (208 Whitaker, 474-5655) to provide reasonable accommodation to students with disabilities.

13. **References listed in syllabus.**

[1] R. C. Aster, B. Borchers, and C. H. Thurber, *Parameter Estimation and Inverse Problems.* Waltham, Mass., USA: Elsevier, 2 ed., 2012.

[2] A. Tarantola, *Inverse Problem Theory and Methods for Model Parameter Estimation.* Philadelphia, Penn., USA: SIAM, 2005.

[3] W. Menke, *Geophysical Data Analysis: Discrete Inverse Theory.* Waltham, Mass., USA: Academic Press, 3 ed., 2012.

[4] R. L. Parker, *Geophysical Inverse Theory.* Princeton, New Jersey, USA: Princeton U. Press, 1994.

[5] S. Weisberg, *Applied Linear Regression.* Hoboken, New Jersey: Wiley, 3 ed., 2005.