Attachment B

Course Change Request

New Course Proposal

Date Submitted: 11/30/17 12:01 pm

Viewing: GEOP 635 : Methods of Geophysical Exploration

Last edit: 02/21/18 1:44 pm

Changes proposed by: sara.baber

Faculty Senate Number

Contact(s)

Name	E-mail	Phone
Sara Baber	sara.baber@tamu.edu	979-845-2734

Course prefix	GEOP	Course number	635
Department	Geology & Geophysics		
College/School	Geosciences		
Academic Level	Graduate		
Academic Level (alternate)	Undergraduate		
Effective term	2019-2020		

Complete Course Title

Methods of Geophysical Exploration

Abbreviated Course Title: METHOD GEOPHYSICAL EXPLORATION

Catalog course description

Introduction to theory of gravity, magnetic, electrical and seismic exploration methods; physical properties of earth materials and their influence on geophysical measurements; limitations of geophysical data in the interpretation of subsurface structure.

Prerequisites and Restrictions

Graduate classification.

Concurrent Enrollment	No		
Should catalog prerequisites / concurrent enrollment be enforced?	No		
Crosslistings	No	Crosslisted With	
Stacked	No	Stacked with	

Semester Credit Hour(s)	3	Contact Hour(s) (per week):	Lecture:	3	Lab: 0	Other:	0
			Total	3			

Repeatable for credit?	No
Three-peat?	No
CIP/Fund Code	4006030002
Default Grade Mode	Letter Grade(G)

In Workflow

1. **GEPL Department Head**
2. **Curricular Services Review**
3. **GE Committee Preparer GR**
4. **GE Committee Chair GR**
5. **GE College Dean GR**
6. **GC Preparer**
7. **GC Chair**
8. **Faculty Senate Preparer**
9. Faculty Senate
10. Provost II
11. President
12. Curricular Services
13. Banner

Approval Path

1. 11/30/17 1:47 pm Michael Pope (mcpope): Approved for GEPL Department Head
2. 12/06/17 4:55 pm Sandra Williams (sandra-williams): Approved for Curricular Services Review
3. 12/07/17 11:15 am Roxanna Russell (rrussell): Approved for GE Committee Preparer GR
4. 02/06/18 11:50 am Christian Brannstrom (cbrannst): Approved for GE Committee Chair GR
5. 02/06/18 11:52 am Christian Brannstrom (cbrannst): Approved for GE College Dean GR
6. 02/16/18 12:53 pm Meagan Kelly (meagankelly): Approved for GC Preparer
7. 03/01/18 3:15 pm LaRhesa Johnson (lrjohnson): Approved for GC Chair

THE COLLEGE OF GEOSCIENCES

SYLLABUS

Course Title and Number	METHODS OF GEOPHYSICAL EXPLORATION GEOP 635 Spring 2018 Semester

Course Overview

GEOP 635 provides foundation on theoretical principles, data acquisition and processing for some of the methods used for natural resources exploration. In order to provide a coherent learning structure, the course is designed in modules. Each module will provide the student with a comprehensive description of two or more geophysical methods: gravity-magnetics, seismic methods, EM methods and well—logging. The student will be introduced to the application of geophysics for subsurface characterization at exploration depths, with emphasis on the relationship between physical properties, subsurface geometries, the geophysical anomalies measured and the geological interpretation. Prerequisite: Graduate Student Standing.

Course Objectives

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

1) Understand and apply the physical principles and of each geophysical method visited.
2) Describe the connection between geophysical anomalies and spatial variations of physical
3) Process potential field data to obtain residual anomaly maps; gravity Bouguer and magnetic RTP residuals
4) Apply a variety of filters to delineate the boundaries of different litho types and the presence of faults
5) Develop a subsurface model of mass densities and magnetic susceptibilities using forward modeling
6) Define the relationship between stresses, strains and elastic parameters
7) Calculate how seismic waves changes direction as seismic impedance changes in the subsurface
8) Identify a variety of seismic events, enhance, remove or transform them to further understanding the geometry of the main rock formations in the subsurface
9) Describe how seismic surveys are carried out onshore and offshore and the necessary data processing steps to obtain an un-migrated seismic section or cube
10) Describe the applications of passive seismic to obtain a low-cost geological model, or to determine the spatio-temporal effects of fracking or production in oilfields
11) Calculate the depth of penetration of diffusing EM fields
12) Assess the usefulness and resolution capabilities of MT and CSEM for mining and oil exploration
13) Define exploration strategies by using two or more geophysical methods to obtain a more reliable model of the subsurface
14) Identify sedimentary rock types by using two or more well-logging techniques
15) Understand and calculate petrophysical quantities such as porosity, oil/water saturation, mass density from well-logging data
16) Identify locations along a wellbore that contains oil or gas

Instructor/ T.A. Information

Instructor's name	Alfonso Benavides
Telephone number	979-820-4412
e-mail address	a.benavides@tamu.edu
Asynchronous lectures	TBD online
Discussion boards/chats	TBD online

Textbook and Resource Materials
(Suggested Books – other readings will be provided online)

Applied Geophysics, by W. M. Telford, L.P. Geldart and R. E. Sheriff. Cambridge University Press. 1990. ISBN978-0521339384

Exploration Geophysics, by H. R. Burger. Prentice Hall. 1992. ISBN 978-0132967730

Course Description
Lectures

The course consist of four (4) modules taught over an 8 week term that covers most of the geophysical methods used in exploration geophysics:
Module 1: Gravity and Magnetics
Module 2: Seismic Methods
Module 3: Electromagnetic methods
Module 4: Geophysical well-logging

Lectures consist of 22 animated slides and audio that provides classroom-type experience. Some of the lectures will be aired live (synchronous streaming), to give the opportunity to interact with the instructor while the others will be available anytime. Live lectures will be recorded and made available to students who are not able to participate live. In either case, lectures feature several questions and suggested problem-solving challenges to engage the student into active learning. Lectures are supplemented by short videos that provide more details about mathematical proofs, problem-solving tutorials, and research papers. It is required that students complete all the lectures in the module in order to have access to the corresponding exam.

Forums

Each week, the course will provide a one-hour discussion forum that requires student to engage in discussions and question/answer rounds. Discussion forums provide a space where general questions can be answered to a broad audience, specific comprehension or problem-solving issues can be addressed in a way similar to a face-to-face lecture. Forums will be scored based on attendance and participation.

Reading and Comprehension

Students are required to read specific chapters or chapter sections of the textbooks and research papers. Each module has one or more research papers with an accompanying questionnaire that will be graded.

Assignments and eLab

Assignments consist of problem-solving exercises that cover analytic and numerical aspects of geophysical theory, data processing and interpretation. For each of the course modules, the student will work on one or more problem-solving assignment and a virtual laboratory (eLab). The eLab part of the assignment provides real data, hands-on experience on selected course topics using previously recorded data from several geophysical surveys. For each practice, students will receive a written list of tasks to be completed, the steps needed to perform the calculations, and a list of information to be included on the final report.

Each practice is considered completed, when the student submits a written technical report. The report should be in the form of a technical communication that may require attaching a spreadsheet workbook or programming codes you developed to complete the tasks. A few geophysical topics will be covered as eLab during the semester. For instance:

1. Gravity Data Preparation and Modeling
2. Analyzing seismic events and CMP velocity analysis

3. Calculation of MT apparent resistivity transfer functions
4. Well-log interpretation

Activity Scoring and Grading

Grading will be based on participation in the online forums, completing the online lectures (synchronous and asynchronous), submitting assignment reports (problem-solving and eLabs), completing successfully online exams for each of the course modules, and answering all the questionnaires from the research papers required for each module. Point distribution is as follows:

Activity	Points
Online Discussion forums (8, 1 point each)	8
Assignments (5, 7 points each)	35
Exam 1	13
Exam 2	16
Exam 3	9
Exam 4	12
Research paper questionnaires (7, 1 point each)	7
TOTAL	**100**

Scale

A 90.0 - 100%
B 80.0 – 89.9%
C 70.0 – 79.9%
D 60.0 – 69.9%
F 0 – 59.9%

This course will follow the University's policy if a student cannot complete assigned activities by the deadlines due to excused absences. http://student-rules.tamu.edu/rule07

Course Modules and Topics

Module 1	Gravity and Magnetics	Topics
	Lecture 01 Gravity and Magnetics Principles 1.25 hrs	Gravity and magnetic sources Newton's law of universal gravitation Coulomb's law Gravity and magnetic forces Newtonian magnetic potential Superposition
	Lecture 02 Gravity and Magnetism of the Earth 1.3 hrs	Gravity acceleration factors Gravity data corrections Gravity anomalies Magnetic factors Magnetic corrections Magnetic anomalies
	Lecture 03 Instruments and Field Operations 1.25 hrs	Gravimeters and magnetometers Measuring gravity and Magnetic fields The gravity and magnetic spectra Field operations
	Lecture 04 Data acquisition and processing	Regional and residual signal Polynomial approximations Fourier Transform

	1.3 hrs	Wavenumber filtering
	Lecture 05 Data Interpretation I 1.3	Anomaly Interpretation Modeling complex 2D and 3D shapes
	Lecture 06 Data Interpretation II 1.5 hrs	Residual anomalies enhancement RTP, RTE Directional derivatives Gradients and analytic signal Non-linear filters

Module 2	**Seismic methods**	**Topics**
	Lecture 07 Wave motion I 1.3 hrs	The seismic experiment Continuous media. Homogeneity and heterogeneity Stress and stress tensor Particle displacement, velocity and acceleration
	Lecture 08 Wave motion II 1.3 hrs	Strain and strain tensor Hooke's law Isotropy and anisotropy Wave equation: P- and S-waves
	Lecture 09 Plane waves and raypaths 1.5 hrs	Wave equation solutions: plane waves Huygens and Fermat principles Snell's law for reflection Snell's law for refraction. Critical angle Generalized Snell's law
	Lecture 10 Traveltime equations 2.5 hrs	Seismic Events Traveltime equations for horizontal interface Traveltime equations for dipping interface diffractions
	Lecture 11 The seismic experiment 1.25 hrs	Sources, receivers and instrumentation Seismic data in time and frequency domains Onshore and offshore surveys
	Lecture 12 Seismic processing 1.3 hrs	Refraction seismic interpretation Reflection seismic CMP processing CMP stacking and seismic sections Migration
	Lecture 13 Specialized techniques: VSP, passive seismic 1.3 hrs	Vertical seismic profiling. Applications Passive seismic experiments

Module 3	**Electromagnetic methods**	**Topics**
	Lecture 14 Magnetotellurics I 1.25 hrs	Conduction mechanisms. Skin depth Basis of the MT method Transfer function and depth of penetration MT in a layered media: apparent resistivity
	Lecture 15 Magnetotellurics II 1.3 hrs	Instrumentation and MT surveys Interpretation of MT data. Inversion MT applications
	Lecture 16 Controlled-source EM I	Principles of EM induction Onshore CSEM experiment Source and receiver types. Data acquisition

	1.5 hrs	CSEM data interpretation
	Lecture 17 Controlled-source EM II 1.5 hrs	Offshore CSEM experiment Source and receiver types Data acquisition. The effect of the water layer Offshore CSEM data interpretation Applications for exploration. Joint interpretation

Module 4	**Well-logging methods**	**Topics**
	Lecture 18 Resistivity logging 1.3 hrs	Rocks and fluids The resistivity experiment: electrode arrays Resistivity logging devices
	Lecture 19 Self-potential logging 1.3 hrs	Self-potential effects Self-potential measurements
	Lecture 20 Gamma and neutron logging 1.5 hrs	Natural radiation in rocks Measuring gamma radiation Gamma logging interpretation Neutron diffusion and measurement Neutron devices Neutron logging interpretation
	Lecture 21 Sonic and EM logging 1.5 hrs	Rock formation velocities Sonic logging tools Sonic data acquisition and interpretation Induction logging fundamentals Induction logging tools: ILD, ILM and SFLU
	Lecture 22 Well logging interpretation 1.5 hrs	Rock type identification Estimation of porosity Gas and oil identification

Academic Engagement/Credit Hour Calculation

Activity	**Assignments**	**Estimated hours for the student**
Academic Engagement	Listening to or reading course lectures: 25 pages per hour (1 per week)	32
	Reading additional website documents: 25 pages per hour (.5 per week)	4
	Reading discussion forums and making responses: 1 hour per week	8
	Taking quizzes and exams: .5 hours per week	6
	Total	50
Preparation (outside of class)	Reading Textbooks	24
	Lecture supplementary videos	6
	Research papers	21
	Exams	8
	Problem solving and assignments	32
	Total	91
Overall Total		**141**

Work Report, Grade Policies and Conflict Resolution

All written work should be submitted on electronic form following the style provided by the Instructor or Teaching Assistant.

Assignments and eLab reports will have due-dates. Failing to submit your work before the due date may result in penalties in the form of dropped points from the score at a rate of 2 points/day.

Completion of the eLab activities is required for the student to get a complete final grade. Failing to meet this requirement would result in an F-grade.

Assignments and exams scores will be provided a week after the entire roster have submitted their work. In case of large roster enrollment, scores may take longer than a week to be available in cases where the assignment has considerable amount of content.

If a student needs to discuss a teaching or grading issue, please talk to the Instructor and/or Teaching Assistant promptly before involving third parties. In case of a grade challenge after the semester is over, you may still discuss the matter with your Instructor and/or Teaching Assistant, After the grade challenge has been requested to the Department, the procedure will require a third party to examine/grade the assignment(s) or exam(s) and determine the final grade.

Additional Information

Spring 2018 Important Calendar Dates (Online Non-Traditional)

March 8, Thursday	First day of class
March 25, Friday	Reading day, no classes
April 19, Tuesday, 5 pm	Last day to Q-drop
May 1, Tuesday	Last day of class.
May 4, Wednesday	Reading day, no classes
May 5-10, R through T	Final examinations
May 11, Wednesday	Grades for degree candidates due
May 16, Monday, noon	All final grades due

Due Dates and Time Zones

This online non-traditional course is taught in an 8 week term – all due dates and deadlines will be updated in the syllabus before the first day of class, and posted in the online course, itself.

Please be advised the times listed here - and any other printed materials - usually refer to the course time zone which is US Central time. (Day Light Saving time is observed until 2:00 AM on Sunday, November 4, 2018.)
By default, all dates and times throughout your Canvas course are displayed according a course's respective time zone. However, you can set your own time zone for your user account and have your local time zone display throughout Canvas. *Displaying dates in your local time may help you stay up to date on assignments and due dates, especially if your course time zone differs significantly from where you reside.*

Texas A&M University Student Services

Texas A&M University offers a variety of student services to on-campus and online students. For more information, please go to: http://distance.tamu.edu/Student-Services

Americans with Disabilities Act (ADA)

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information, visit http://disability.tamu.edu.

Academic Integrity

For additional information please visit: http://aggiehonor.tamu.edu

Aggie Code of Honor

For many years Aggies have followed a Code of Honor, which is stated in this very simple verse:
"An Aggie does not lie, cheat or steal or tolerate those who do."
The Aggie Code of Honor is an effort to unify the aims of all Texas A&M men and women toward a high code of ethics and personal dignity. For most, living under this code will be no problem, as it asks nothing of a person that is beyond reason. It only calls for honesty and integrity, characteristics that Aggies have always exemplified. The Aggie Code of Honor functions as a symbol to all Aggies, promoting understanding and loyalty to truth and confidence in each other.

Alternate Grade Modes	Satisfactory/Unsatisfactory
Method of instruction	Lecture
Will sections of this course be taught as non-traditional? (i.e., parts of term, distance education)	Yes

Learning Outcomes

Meets traditional face-to-face learning outcomes.

Describe how learning outcomes are met or provide justification why they are not met.

Course underwent college curriculum review in order to verify that online outcomes meet traditional face-to-face learning outcomes. Review included comparison of syllabi following a college approved checklist.

Hours

Meets traditional face-to-face hours.

Describe how hours are met or provide justification why they are not met.

Course underwent college curriculum review in order to verify that academic engagement and student preparation hours are equivalent to those for the traditional face-to-face course.. Review included calculation of hours following a college approved worksheet.

Will this course be taught as a distance education course?	Yes
I verify that I have reviewed the FAQ for Export Control Basics for Distance Education.	Yes
Is 100% of this course going to be taught in Texas?	Yes
Will classroom space be needed for this course?	No

This will be a required course or an elective course for the following programs:

Required (select program)

Program(s)
(MGS-GEOS) Master of Geoscience in Geoscience

Elective (select program)

Course Syllabus

Syllabus:	Upload syllabus
Upload syllabus	Syllabus GEOP 635_11-30.pdf
Letters of support or other documentation	No
Additional information	
Reviewer Comments	**sara.baber (11/29/17 10:03 am):** Updated syllabus has been sent to the Curricular Services Review Team. Thank you, Sara Baber 11-29-17 **Sandra Williams (sandra-williams) (11/29/17 2:21 pm):** Rollback: Course form shows "03" lecture contact hours

- do you mean "3"? Syllabus shows 689 - should only show proposed new course number; prerequisites must match course form; grading scale - what grade will a student get if they get 89.45 (A or B) - same issue with other grades; missing link to student rule 7 regarding attendance/make-up/late-work.
Sandra Williams (sandra-williams) (11/30/17 10:12 am): Rollback: As requested.
Sandra Williams (sandra-williams) (12/06/17 4:55 pm): Update received.

Reported to state?

Add

Key: 18395