New Course Proposal

Date Submitted: 03/08/18 3:57 pm

Viewing: GEOL 616: Petroleum Systems Analysis and Basin Modeling

Last edit: 06/15/18 9:34 am
Changes proposed by: david-w-sparks

Course prefix GEOL
Course number 616
Department Geology & Geophysics
College/School Geosciences
Academic Level Graduate
Effective term 2019-2020

Complete Course Title Petroleum Systems Analysis and Basin Modeling
Abbreviated Course Title PETRO SYS ANLY & BASIN MODLG

Catalog course description
Geological processes in sedimentary basins; petroleum system elements and modeling; hydrocarbon generation, expulsion, migration, accumulation; fluid analysis; multi-disciplinary data integration; basin modeling software and simulation.

Prerequisites and Restrictions
Should catalog prerequisites / concurrent enrollment be enforced? No
Crosslistings No Crosslisted With
Stacked No Stacked with

Semester 3 Contact Hour(s) Lecture: 3 Total 3 Lab: 0 Other: 0
Credit Hour(s)
Repeatable for credit? No
CIP/Fund Code 4006010002
Default Grade Mode Letter Grade(G)

Method of instruction
Lecture

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. 03/08/18 4:04 pm Michael Pope (mcpope): Approved for GEPL Department Head
2. 03/08/18 6:35 pm Sandra Williams (sandra-williams): Approved for Curricular Services Review
3. 03/09/18 8:17 am Roxanna Russell (rrussell): Approved for GE Committee Preparer GR
4. 03/09/18 9:08 am Chrisan Brannstrom (cbrannst): Approved for GE Committee Chair GR
5. 03/09/18 9:12 am Chrisan Brannstrom (cbrannst): Approved for GE College Dean GR
6. 03/26/18 9:01 am Meagan Kelly (meagankelly): Approved for GC Preparer
7. 04/05/18 3:25 pm LaRhesa Johnson (lrjohnson): Approved for GC Chair
8. 04/11/18 3:28 pm Jan Helgoth (helgoth): Approved for Faculty Senate Preparer
9. 05/15/18 3:58 pm Janet Gonzales (janet-...
Will sections of this course be taught as non-traditional? (i.e., parts of term, distance education)  No

Will this course be taught as a distance education course?  No

Is 100% of this course going to be taught in Texas?  Yes

Will classroom space be needed for this course?  Yes

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

Required (select program)

Elective (select program)

<table>
<thead>
<tr>
<th>Program(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(MS-GEOL) Master of Science in Geology</td>
</tr>
<tr>
<td>(MS-GEOP) Master of Science in Geophysics</td>
</tr>
<tr>
<td>(PHD-GEOL) Doctor of Philosophy in Geology</td>
</tr>
<tr>
<td>(PHD-GEOP) Doctor of Philosophy in Geophysics</td>
</tr>
</tbody>
</table>

Course Syllabus

Syllabus: Upload syllabus


Letters of support or other documentation  No

Additional information

Reviewer Comments  
Sandra Williams (sandra-williams) (03/05/18 9:38 am): Rollback: Syllabus shows reference to "689" as the course number. Also, incorrect Aggie Honor Code website listed.
Sandra Williams (sandra-williams) (03/05/18 4:35 pm): Rollback: Please remove reference to GEOL 689 from the syllabus.
Janet Gonzales (janet-gonzales) (06/15/18 9:34 am): Rollback: Glitch in CARS, was not "approved" to be moved to Provost II.
Geology 616, Petroleum Systems Analysis and Basin Modeling  Fall, 2018

Credits: 3  
Time: TBD  
Place: TBD  
Instructors: Dr. Mauro Becker, HALB 255, mbecker@tamu.edu  
Dr. Andrea Miceli Romero, HALB 253, miceli@tamu.edu  
Chevron ETC Hydrocarbon Charge Team  
Office hours: Thursday 1:00-3:00 pm or by appointment

Course Description: GEOL 616. Petroleum Systems Analysis and Basin Modeling. (3-0). Credits 3. Geological processes in sedimentary basins; petroleum system elements and modeling; hydrocarbon generation, expulsion, migration, accumulation; fluid analysis; multi-disciplinary data integration; basin modeling software and simulation.

Learning Outcomes: At the end of this course, a successful student will be able to

• Describe the petroleum system elements and the importance of basin modeling in reducing uncertainty in hydrocarbon exploration and production.  
• Recognize the mechanisms and controls of hydrocarbon generation, expulsion, migration, accumulation, and alteration.  
• Understand the integration and applications of multi-disciplinary data to generate a basin model for petroleum systems analysis.  
• Identify the series of parameters and common workflows needed to perform a simulation in a basin modeling software.

Prerequisite: Senior and Graduate classification.

Grading:  
Grade distribution: 90-100%: A; 80-89%: B; 70-79%: C; 60-70%: D; < 60%: F.  
Grades will be earned based on a series of quizzes, papers, class participation, and a final case study written report and oral presentation.

• Quizzes (15%): Quizzes will be given out every other week and will cover topics from all the lectures up to that time.  
• Written paper 1 (20%)* - topic will be assigned on 08/31  
• Written paper 2 (25%)* - topic will be assigned on 10/05  
• Final case study written report and oral presentation (30%): Each student must turn in a report and deliver a 15-minute oral presentation based on a case study selected in class.  
• Class participation (10%): Grading will be based on contributions to improved learning during lectures and student presentations.

* Paper topics will be assigned during class. Papers will be due in class on the day stated on the handout. Late projects will lose 10% of the grade and an additional 10% for every 48 hours after the due date, until delivered.
<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture Topic</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/31</td>
<td>Introduction to petroleum systems analysis and basin modeling</td>
<td>Syllabus reading and Lecture Paper 1 topic assignment and selection of case study project Lecture and Discussion</td>
</tr>
<tr>
<td>09/07</td>
<td>Origins of oil and gas, hydrocarbon source rocks</td>
<td>Lecture and Discussion</td>
</tr>
<tr>
<td>09/14</td>
<td>Compaction and pore pressure</td>
<td>Lecture and Discussion</td>
</tr>
<tr>
<td>09/21</td>
<td>Thermal maturity parameters and heat flow analysis</td>
<td>Lecture and Discussion</td>
</tr>
<tr>
<td>09/28</td>
<td>Thermal maturity parameters and heat flow analysis (cont.)</td>
<td>Quiz</td>
</tr>
<tr>
<td>10/05</td>
<td>Hydrocarbon generation, kinetics</td>
<td>Lecture and Discussion</td>
</tr>
<tr>
<td>10/12</td>
<td>Hydrocarbon migration and accumulation; alteration processes</td>
<td>Paper 2 topic assignment</td>
</tr>
<tr>
<td>10/19</td>
<td>Reservoir rocks and seals</td>
<td>Lecture and Discussion</td>
</tr>
<tr>
<td>10/26</td>
<td>Hydrocarbon traps formation and timing</td>
<td>Quiz</td>
</tr>
<tr>
<td>11/02</td>
<td>Fluid properties and geochemistry</td>
<td>Lecture and Discussion</td>
</tr>
<tr>
<td>11/09</td>
<td>Basin modeling structure and workflows</td>
<td>Lecture and Discussion</td>
</tr>
<tr>
<td>11/16</td>
<td>Basin modeling software demonstration</td>
<td>Quiz</td>
</tr>
<tr>
<td>11/23</td>
<td>Thanksgiving Break</td>
<td>Paper 2 Due</td>
</tr>
<tr>
<td>11/30</td>
<td>Student Presentations – Case studies</td>
<td>Oral Presentations and written reports due</td>
</tr>
<tr>
<td>12/07</td>
<td>Student Presentations – Case studies</td>
<td>Oral Presentations</td>
</tr>
</tbody>
</table>

**Textbook and/or Resource Material:**


You will be provided with a suggested reading list that will offer background for the lectures. You will be encouraged to read the recommended papers before class in order to participate in discussions.
**Aggie Code of Honor**

“An Aggie does not lie, cheat, or steal, or tolerate those who do.”

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

**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.

**Absence/Makeup Policy**

This class will follow the University’s policy for excused absences and missed work. Assignments will not be accepted after the due date without an excuse that meets the University approved absence standard. If a student must miss an exam or assignment due date, he/she must notify me in advance, if feasible, or within 48 hours after the date. For more information, please see Section 7 of the student rules: http://student-rules.tamu.edu/rule07.

**Copyright Policy Statement**

All materials used in this class are copyrighted. These materials include but are not limited to syllabi, quizzes, in-class materials, and additional problem sets. Because these materials are copyrighted, you do not have the right to copy the handouts, unless permission is expressly granted.
### Course Change Request

#### New Course Proposal

Date Submitted: 11/14/17 9:06 am

**Viewing:** LAW 764: Introduction to the United States Legal system

Last edit: 06/15/18 9:38 am

Changes proposed by: ruthsmith

#### Contact(s)

<table>
<thead>
<tr>
<th>Name</th>
<th>E-mail</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ruth Smith</td>
<td><a href="mailto:ruthsmith@tamu.edu">ruthsmith@tamu.edu</a></td>
<td>817-212-4046</td>
</tr>
</tbody>
</table>

#### Course prefix

| LAW |

#### Course number

| 764 |

#### Department

| School of Law |

#### College/School

| School of Law |

#### Academic Level

| Graduate |

#### Academic Level (alternate)

| Graduate |

#### Effective term

| 2018-2019 |

#### Complete Course Title

**Introduction to the United States Legal system**

#### Abbreviated Course Title

**INTRO TO U.S. LEGAL SYSTEM**

#### Catalog course description

Broad survey of the doctrine and structure of the legal system in the United States, including major common law, statutory and constitutional topics; context for the operation of law in the United States and improves understanding of specific doctrine and practices learned elsewhere.

#### Prerequisites and Restrictions

Approval of program director.

#### Concurrent Enrollment

No

#### Should catalog prerequisites / concurrent enrollment be enforced?

No

#### Crosslistings

No

#### Crosslisted With

No

#### Stacked

No

#### Stacked with

No

#### Semester

| 3 |

#### Credit Hour(s)

| 3 (per week): |

#### Contact Hour(s)

| 3 |

#### Lecture:

| Total |

#### Lab:

| 0 |

#### Other:

| 0 |

#### Repeatable for credit?

No

#### Three-peat?

No

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**In Workflow**

1. Curricular Services Review
2. SL Committee Preparer
3. SL College Dean
4. GC Preparer
5. GC Chair
6. Faculty Senate Preparer
7. Faculty Senate
8. Provost II
9. President
10. Curricular Services
11. Banner

**Approval Path**

1. 11/17/17 8:17 am Sandra Williams (sandra-williams): Approved for Curricular Services Review
2. 11/20/17 9:28 am Ruth Smith (ruthsmith): Approved for SL Committee Preparer
3. 03/23/18 3:39 pm Cynthia Alkon (calkon): Approved for SL College Dean
4. 03/26/18 9:04 am Meagan Kelly (meagankelly): Approved for GC Preparer
5. 04/05/18 3:25 pm LaRhessa Johnson (lrjohnson): Approved for GC Chair
6. 04/11/18 4:11 pm Jan Helgoth (helgoth): Approved for Faculty Senate Preparer
7. 05/15/18 4:00 pm Janet Gonzales (janet-gonzales): Approved for Faculty Senate
8. 06/15/18 9:38 am Janet Gonzales (janet-gonzales): Rollback to Faculty Senate for Provost II
CIP/Fund Code: 2201010008
Default Grade Mode: Letter Grade (G)
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)
No

Will this course be taught as a distance education course?
No

Is 100% of this course going to be taught in Texas?
Yes

Will classroom space be needed for this course?
Yes

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

<table>
<thead>
<tr>
<th>Program(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(MJ-INPR) Master of Jurisprudence in Intellectual Property</td>
</tr>
<tr>
<td>(MJ-JURS) Master of Jurisprudence</td>
</tr>
</tbody>
</table>

Course Syllabus

Syllabus: Upload syllabus
Upload syllabus: Intro to USLS rev.pdf

Letters of support or other documentation
No

Additional information

Reviewer Comments
Sandra Williams (sandra-williams) (11/09/17 8:30 pm): Rollback: Catalog course description needs to be edited to comply with style guide for course descriptions (http://registrar.tamu.edu/Our-Services/Curricular-Services/Catalog/Style-Guide-for-Catalog-Course-Descriptions). Also, syllabus shows only 12 weeks - is that correct or is the course going to be taught in a non-traditional format (different parts of term)? Question on form shows "NO".
Sandra Williams (sandra-williams) (11/12/17 12:09 pm): Rollback: Syllabus is missing course number, course description, prerequisites, missing link specific to student rule 7.
Sandra Williams (sandra-williams) (11/17/17 8:17 am): Edits made to catalog course description.
Janet Gonzales (janet-gonzales) (06/15/18 9:38 am): Rollback: Glitch in CARS, was not "approved" to be moved to Provost II.

Reported to state?
Add

Key: 18359
Introduction to the U.S. Legal System
Texas A&M University School of Law
LAW-764

Course Syllabus

Course Description: A broad survey of the doctrine and structure of the legal system in the United States, including major common law, statutory, and constitutional topics. Provides context for the operation of law in the United States and improves understanding of specific doctrine and practices learned elsewhere.

Prerequisites: Approval of program director.

Instructional Methods: This course will use a variety of instructional methods including assigned readings, Socratic dialogue, problem solving and analysis, and interactive exercises and assessments.

Course Objectives:

- Understand, at an introductory level, how the United States legal system functions, including the comparative positions of case law, statutory law, administrative regulations, and constitutional law;
- Recognize the basic and default allocation of jurisdiction over the development of legal doctrine in a federal system where both state and national governments are major participants;
- Be able to recognize major areas of legal doctrine in the United States, including topics derived from English common law (like torts and real property), topics substantially evolved from English origins (like civil procedure and intellectual property), and topics of substantially American design (like U.S. Constitutional law); and
- Understand the participatory roles of both lawyers and non-lawyers in the functioning of the United States legal system.
- Have experience conducting yourself in an ethical and professional manner in the use of legal analytical skills, both in classroom discussion and in outside preparation for class.

Required Text and Other Readings:

- You should bring the textbook to every class. You may, during some weeks, be assigned supplemental readings outside of *Overview of U.S. Law*. In those situations, the material will be provided to you, generally on the eCampus site for this course.
Grading Policies:

LL.M and M.Jur. students follow the grading scale and grading policies for graduate students set forth at [http://student-rules.tamu.edu/rule10](http://student-rules.tamu.edu/rule10) (Student Rule 10). Grades for this graduate course are without pluses or minuses. A grade of A, B, or C is required to pass the course. The final examination in this course will be a limited open-book examination. Students may use only hard copy materials and will not be allowed to use e-books or other electronic materials during the examination.

The final grades for this course will be weighted as follows:

- Class Participation (100 points) ................................................................. 10%
- Homework Assignments (250 points) ......................................................... 25%
- Quizzes (250 points) ................................................................................... 25%
- Final Examination (400 points) .................................................................. 40%

The following total point scores will result in the grades shown:

- A = 876 – 1000
- B = 776 – 875
- C = 651 – 775
- D = 551 – 650
- F = Below 551

Statement on Credit Hours: The law school adheres to the federal and American Bar Association (“ABA”) definitions of a credit hour. According to ABA Standard 310(b)(1), “a ‘credit hour’ is an amount of work that reasonably approximates: (1) not less than 50 minutes of classroom or direct faculty instruction and two hours of out-of-class student work per week for fifteen weeks, or the equivalent amount of work over a different amount of time.” See also 34 C.F.R. § 600.2. Texas A&M University School of Law uses a twelve-week semester. Applying these rules to this three credit-hour class, you are expected to spend three actual hours per week (180 minutes) in class (including engaging with online class materials). Outside of the classroom component for a three-credit course, you should be spending a minimum of seven hours (420 minutes) of study time weekly in addition to class time. For more information, see the law school’s [Credit Hour Policy](http://student-rules.tamu.edu/). 

Attendance Policy: LL.M. and M.Jur. students are required to adhere to the attendance policies and makeup policies for graduate students set forth in University Student Rule 7, which is available at [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/)

This course is scheduled to have (1) twelve “online classes” and (2) twelve live classroom meetings during the fall semester. To be counted as present for an online class, you must view that week’s assigned online videos and complete any assignment associated with those videos by within the deadline and other parameters set by your professor.

A student who violates the Code of Conduct by disrupting the live classroom or interfering with the right of others in the class to learn may be asked to leave the class. Any student asked to leave the class for disruptive conduct will be counted as absent for that class meeting, and the absence will count toward the maximum allowed absences. Attendance may be factored into your course grade.
You are responsible for any material covered in a missed class, regardless of the reason for your absence.

Academic Integrity and Professionalism:

- **Aggie Code of Honor:** An Aggie does not lie, cheat or steal, or tolerate those who do. For additional information, please visit: [http://aggiehonor.tamu.edu](http://aggiehonor.tamu.edu) and the law school [Student Handbook](http://aggiehonor.tamu.edu).

- **Professionalism:** Law school is professional school, and you are expected and obliged to conduct yourself accordingly. What is professionalism? Professionalism is conduct consistent with civility, honesty, integrity, character, fairness, competence, ethical conduct, public service, and respect for the rule of law. Our intent is that we will model professionalism in all of our interactions in and around this course.

**Law School Disability Policy:** 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 the Assistant Dean of Students, Rosalind Jeffers (rjeffers@law.tamu.edu). Due to the fact that the law school frequently requires or utilizes testing anonymity, students should not discuss their disabilities with professors. For assistance, students should consult with Dean Jeffers. For additional information, visit [http://law.tamu.edu/current-students/student-affairs/exam-accommodation](http://law.tamu.edu/current-students/student-affairs/exam-accommodation).

**Syllabus May Change:** Course syllabi are intended to provide students with basic information concerning a course and give you some idea of what lies ahead for the semester. Faculty teaching this course may, however, change or expand upon any part of this syllabus during the semester as circumstances warrant. For that reason, pay attention to announcements in class, as well as to email or postings on the course eCampus site.
**Planned Topics and Readings:**

The grid below shows the pace and content of the material to be covered. We may, however, with notice to you, take material in a different order if class circumstances (including professor availability) so require.

<table>
<thead>
<tr>
<th>Week #</th>
<th>Topic</th>
<th>Overview of U.S. Law Reading Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overview of the U.S. Legal System</td>
<td>Chapter 1</td>
</tr>
<tr>
<td>2</td>
<td>Jurisdiction &amp; Civil Procedure</td>
<td>Chapter 5</td>
</tr>
<tr>
<td>3</td>
<td>Torts &amp; Personal Responsibilities</td>
<td>Chapter 3</td>
</tr>
<tr>
<td>4</td>
<td>Criminal Justice</td>
<td>Chapter 4</td>
</tr>
<tr>
<td>5</td>
<td>Evidence</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>6</td>
<td>Choice of Law and Enforcement of Judgments</td>
<td>Chapter 16</td>
</tr>
<tr>
<td>7</td>
<td>Constitutional Law</td>
<td>Chapter 7</td>
</tr>
<tr>
<td>8</td>
<td>Property Law</td>
<td>Chapter 8</td>
</tr>
<tr>
<td>9</td>
<td>Intellectual Property Law</td>
<td>Chapter 9</td>
</tr>
<tr>
<td>10</td>
<td>Wills, Trusts &amp; Estates</td>
<td>Chapter 13</td>
</tr>
<tr>
<td>11</td>
<td>Administrative Law</td>
<td>Chapter 15</td>
</tr>
<tr>
<td>12</td>
<td>Professional Responsibility &amp; the Practice of Law</td>
<td>Chapters 10 &amp; 17</td>
</tr>
</tbody>
</table>
**Course Change Request**

**New Course Proposal**

Date Submitted: 03/21/18 1:57 pm

**Viewing: MEEN 623 : Tensor Analysis for Engineers**

Last edit: 06/15/18 9:43 am

Changes proposed by: tmorrel

<table>
<thead>
<tr>
<th>Contact(s)</th>
<th>Name</th>
<th>E-mail</th>
<th>Phone</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Tandilyn Morrel</td>
<td><a href="mailto:tmorrel@tamu.edu">tmorrel@tamu.edu</a></td>
<td>979-845-6883</td>
</tr>
</tbody>
</table>

Course prefix MEEN

Course number 623

Department Mechanical Engineering

College/School College of Engineering

Academic Level Graduate

Effective term 2019-2020

Complete Course Title

**Abbreviated Course Title**

TENSOR ANALYSIS FOR ENGINEERS

Catalog course description

Tensors in three-dimensional Euclidean space specialized for engineering applications including index notation, tensor operations, contraction of tensors, Kronecker delta, permutation tensor, Jacobian transformation, Reynolds Transport Theorem, eigenvalue and eigenvector of a second order tensors, co- and contravariant base vectors, metric coefficients, derivatives of the base vectors, Christoffel symbols, transformation of Navier-Stokes equation, Riemann space, Riemann metric, Riemann arid Christoffel surface tensor, Ricci theorem, Lorenz transformation, curvature tensor and Einstein tensor.

Prerequisites and Restrictions

Graduate classification.

Should catalog prerequisites / concurrent enrollment be enforced?

No

Crosslisted with

No

Stacked

No

Semester 3

Credit Hour(s)

3

Contact Hour(s)

3

Lecture: 3

Total: 3

Lab: 0

Other: 0

Repeatable for credit? No

CIP/Fund Code 1419010006

Default Grade Mode Letter Grade(G)

Method of instruction Lecture

In Workflow

1. MEEN Department Head
2. Curricular Services Review
3. EN Committee Preparer GR
4. EN Committee Chair GR
5. EN 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. 03/26/18 1:13 pm Dan McAdams (dmcadams): Approved for MEEN Department Head
2. 03/26/18 1:16 pm Sandra Williams (sandra-williams): Approved for Curricular Services Review
3. 03/26/18 4:21 pm Tandilyn Morrel (tmorrel): Approved for EN Committee Preparer GR
4. 03/26/18 4:29 pm Harry Hogan (h-hogan): Approved for EN Committee Chair GR
5. 03/26/18 4:32 pm Harry Hogan (h-hogan): Approved for EN College Dean GR
6. 03/28/18 8:42 am LaRhesa Johnson (lrjohnson): Approved for GC Preparer
7. 04/02/18 2:00 pm LaRhesa Johnson (lrjohnson): Approved for GC Chair
8. 04/11/18 3:28 pm Jan Helgoth (helgoth): Approved for Faculty Senate Preparer
9. 05/15/18 4:04 pm Janet Gonzales (janet-
Will sections of this course be taught as non-traditional? (i.e., parts of term, distance education) No

Will this course be taught as a distance education course? No

Is 100% of this course going to be taught in Texas? Yes

Will classroom space be needed for this course? Yes

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

Required (select program)

Elective (select program)

<table>
<thead>
<tr>
<th>Program(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(MEN-MEEN) Master of Engineering in Mechanical Engineering</td>
</tr>
<tr>
<td>(MS-MEEN) Master of Science in Mechanical Engineering</td>
</tr>
<tr>
<td>(PHD-MEEN) Doctor of Philosophy in Mechanical Engineering</td>
</tr>
</tbody>
</table>

Course Syllabus

Syllabus: Upload syllabus

Upload syllabus

MEEN 623- Tensor Analysis for Engineers_Fall 2018_revised.doc
MEEN 623- Tensor Analysis for Engineers_Fall 2018_revised.pdf

Letters of support or other documentation No

Additional information Syllabus revised to reflect requested changes.

Reviewer Comments

Sandra Williams (sandra-williams) (03/05/18 9:47 am): Rollback: Syllabus missing course title; link to student rule 7 regarding absences/make-up work is missing; grade of "F" is missing from grading scale (?). Sandra Williams (sandra-williams) (03/26/18 1:16 pm): Updating received. Moving forward...assume this is a traditional course.

Janet Gonzales (janet-gonzales) (06/15/18 9:43 am): Rollback: Glitch in CARS, was not "approved" to be moved to Provost II.
Course title and number: MEEN 623: Tensor Analysis for Engineers
Term (e.g., Fall 200X): Fall 2018
Meeting times and location: TBD

Course Description and Prerequisites
Tensors in three-dimensional Euclidean space specialized for engineering applications including but not limited to: Index notation, tensor operations, contraction of tensors, Kronecker delta, permutation tensor, Jacobian transformation, Reynolds Transport Theorem, eigenvalue and eigenvector of a second order tensors, co- and contravariant base vectors, metric coefficients, derivatives of the base vectors, Christoffel symbols, transformation of Navier-Stokes equation, Riemann space, Riemann metric, Riemann and Christoffel surface tensor, Ricci theorem, Lorenz transformation, curvature tensor and Einstein tensor.

Learning Outcomes or Course Objectives
The course is intended to provide the engineering students with a solid education in tensor analysis. In a systematic manner, the course provides the students with a solid knowledge of tensor analysis essential to easily understand the fundamental and advanced topics of computational fluid mechanics, continuum mechanics, solid mechanics, bio-engineering, civil engineering, and electrical engineering mentioned preciously.

Attendance:
The university views class attendance as an individual student responsibility. Please refer to (http://student-rules.tamu.edu/rule07).

Instructor Information
Name: Dr. –Ing. Meinhard T. Schobeiri
Telephone number: 979-845-0819
Email address: tschobeiri@tamu.edu
Office hours: TBD
Office location: EPB-Building, Room 121

Textbook and/or Resource Material
Recommended Texts:
For application of tensors in Fluid Mechanics: Applied Fluid Mechanics for Engineers (A graduate textbook) Author: Meinhard T. Schobeiri
ISBN 978-0-07-180004-4
2014 McGraw Hill

Grading Policies
Grading Policy
Homework and projects 70%
Final exam 30%
Total 100%

Grading Scale
90% and above A
80-89.5% B
70-79.5% C
60-69.5% D
50 – 0% F
1 Introduction
1. Tensors in Three-Dimensional Euclidean Space
   1.1 Coordinate system vs. Frame of Reference
   1.2 Order of Tensors: Zeroth, First, Second and Higher Order Tensors
   1.3 Orthogonal, Non-orthogonal, Curvilinear Coordinates and Bases
   1.4 Cartesian Tensors, Summation Convention, Index Notation
   1.5 Coordinate Transformation
   1.6 Applications

2 Vectors as the First Order Tensor
   2.1 Vector Operations: Scalar, Vector and Tensor Products
   2.2.1 Scalar Product
   2.2.2 Vector or Cross Product
   2.2.3 Tensor product
   2.2.4 Contraction of Tensors
   2.2.5 Kronecker Delta, Permutation Symbol
   2.6 Applications

3 Second Order Tensors
   3.1 Operations: Inner Product of a Second Order Tensor with Tensors of Different Orders
   3.2.1 Product of a Second Order Tensor with a Zeroth Order Tensor
   3.2.2 Inner Product of a Second Order Tensor with a First Order Tensor
   3.2.3 Inner Product of a Second Order Tensor with a Second Order Higher Order Tensor
   3.2.4 Change the Order of Tensors
   3.2.5 Unit Tensor, Levi-Civita e-tensor, Product of e-tensors
   3.7 Applications

4 Differential Operators
   4.1 Substantial Differential Operators
   4.2 Spatial Differential operator V
   4.3 Laplace Operator \( \nabla^2 \)
   4.4 Operator V Applied to Different Tensors
   4.5.1 Scalar Product of V and a First Order Tensor
   4.5.2 Cross Product of V and a First Order Tensor
   4.5.3 Permutation symbol
   4.5.4 Scalar Product of V and a Second Order Tensor
   4.5.5 Total Stress Tensor, Shear Stress, Normal Stress Tensor
   4.5.6 Decomposition of a Second order Tensor into Symmetric and Ant Symmetric Part
   4.5.7 Deformation, Rotation Tensors, Principal Invariants
   4.5.8 Eigenvalue and Eigenvector of a Second Order Tensor
   4.9 Applications

5 Jacobian Function
   5.1 Jacobian Transformation Function and its Material Derivative
   5.2 Levi-Civita Density
   5.3 Translation, Deformation, Rotation
   5.4 Reynolds Transport Theorem
   5.5 Applications

6 Tensor Operations in Orthogonal Curvilinear Coordinate Systems
   6.1 Change of Coordinate System
   6.2 Co- and Contravariant Base Vectors, Metric Coefficients
   6.3 Raising and Lowering Tensor Indices
   6.4 Physical Components of a Vector
   6.5 Derivatives of the Base Vectors, Christoffel Symbols
   6.6 Spatial Derivatives in Curvilinear Coordinate System
   6.6.1 Co-variant derivatives, covariant operator v 1
   6.6.1 Application of V and VI to Tensor Functions
6.7 Application Example 1: Inviscid Incompressible Flow Motion
6.7.1 Equation of Motion in Curvilinear Coordinate Systems
6.7.2 Special Case: Cylindrical Coordinate System
6.7.3 Base Vectors, Metric Coefficients
6.7.4 Christoffel Symbols
6.7.5 Introduction of Physical Components
6.8. Application Example 2: Viscous Flow Motion
6.8.1 Equation of Motion in Curvilinear Coordinate Systems
6.8.2 Special Case: Cylindrical Coordinate System
6.9 Applications

7. Riemann Space
7.1 Geodesics, Christoffel Symbols
7.2 Gauss Curvature, Levi-Civita Symbols
7.2. Transformation of the Christoffel Symbols
7.3 Partial Derivative of the Fundamental Tensor
7.4 Riemann Coordinates
7.5 Ricci Theorem, Ricci Tensor and Ricci Scalar
7.6 Riemann Christoffel Curvature Tensor

8 Einstein Field Equation
8.1 Equivalence Principle
8.2 Principle of Covariance
8.3 Lorentz Transformation
8.4 Einstein Energy and Momentum Tensor
8.5 Einstein Field Equation Tensor

Americans with Disabilities Act (ADA)
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Academic Integrity
For additional information please visit: http://aggiehonor.tamu.edu

Aggie Honor Code: “An Aggie does not lie, cheat, or steal, or tolerate those who do.”
Upon accepting admission to Texas A&M University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning and to follow the philosophy and rules of the Honor System. Students will be required to state their commitment on examinations, research papers, and other academic work. Ignorance of the rules does not exclude any member of the Texas A&M University community from the requirements or the processes of the Honor System. For additional information please visit: www.tamu.edu/aggiehonor/. On all course work, assignments, and examinations at Texas A&M University, the following Honor Pledge is implied regardless if it is preprinted and signed by the student: “On my honor, as an Aggie, I have neither given nor received unauthorized aid on this academic work.”

Ethical and respectful behavior and academic honesty are expected and required of students and even more so of engineers and scientists. Evidence of cheating during an exam may result in failure of the entire course for the student(s) in question. The same goes for homework that is not your own work. Examples of cheating include, but are not limited to, looking at someone else’s work for answers or hints during an exam; copying the work of someone else on graded homework; using available homework solutions from an electronic or hardcopy source to help complete your graded homework; secretly passing exam answers between students in a large (or otherwise) classroom; use of electronic communication devices during an exam; any speaking during an exam, in any language; consulting your textbook or class notes during a closed-book exam; sharing calculators during an exam.
Course title and number: MEEN 623: Tensor Analysis for Engineers
Term (e.g., Fall 200X): Fall 2018
Meeting times and location: TBD

Course Description and Prerequisites
Tensors in three-dimensional Euclidean space specialized for engineering applications including but not limited to: Index notation, tensor operations, contraction of tensors, Kronecker delta, permutation tensor, Jacobian transformation, Reynolds Transport Theorem, eigenvalue and eigenvector of a second order tensors, co- and contravariant base vectors, metric coefficients, derivatives of the base vectors, Christoffel symbols, transformation of Navier-Stokes equation, Riemann space, Riemann metric, Riemann and Christoffel surface tensor, Ricci theorem, Lorenz transformation, curvature tensor and Einstein tensor.

Learning Outcomes or Course Objectives
The course is intended to provide the engineering students with a solid education in tensor analysis. In a systematic manner, the course provides the students with a sold knowledge of tensor analysis essential to easily understand the fundamental and advanced topics of computational fluid mechanics, continuum mechanics, solid mechanics, bio-engineering, civil engineering, and electrical engineering mentioned preciously.

Attendance:
The university views class attendance as an individual student responsibility. Please refer to (http://student-rules.tamu.edu/rule07).

Instructor Information
Name: Dr. –Ing. Meinhard T. Schobeiri
Telephone number: 979-845-0819
Email address: tschobeiri@tamu.edu
Office hours: TBD
Office location: EPB-Building, Room 121

Textbook and/or Resource Material
Recommended Texts:
For application of tensors in Fluid Mechanics: Applied Fluid Mechanics for Engineers (A graduate textbook) Author: Meinhard T. Schobeiri
ISBN 978-0-07-180004-4
2014 McGraw Hill

Grading Policies
Grading Policy
Homework and projects: 70%
Final exam: 30%
Total: 100%

Grading Scale
90% and above: A
80-89.5%: B
70-79.5%: C
60-69.5%: D
50 – 0%: F
Course Topics, Calendar of Activities, Major Assignment Dates

1 Introduction
I. Tensors in Three-Dimensional Euclidean Space
1.1 Coordinate system vs. Frame of Reference
1.1.1 Order of Tensors: Zeroth, First, Second and Higher Order Tensors
1.1.3 Orthogonal, Non-orthogonal, Curvilinear Coordinates and Bases
1.1.4 Cartesian Tensors, Summation Convention, Index Notation
1.1.5 Coordinate Transformation
1.2 Applications

2 Vectors as the First Order Tensor
2.1 Vector Operations: Scalar, Vector and Tensor Products
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3.2.5 Unit Tensor, Levi-Civita e-tensor, Product of e-tensors
3.2 Applications

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6.6.1 Co-variant derivatives, covariant operator \( v_1 \)
6.6.1 Application of V and VI to Tensor Functions
Application Example 1: Inviscid Incompressible Flow Motion

6.7.1 Equation of Motion in Curvilinear Coordinate Systems
6.7.2 Special Case: Cylindrical Coordinate System
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6.7.5 Introduction of Physical Components

6.8 Application Example 2: Viscous Flow Motion

6.8.1 Equation of Motion in Curvilinear Coordinate Systems
6.8.2 Special Case: Cylindrical Coordinate System

6.9 Applications

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7.1 Geodesics, Christoffel Symbols
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7.2. Transformation of the Christoffel Symbols
7.3 Partial Derivative of the Fundamental Tensor
7.4 Riemann Coordinates
7.5 Ricci Theorem, Ricci Tensor and Ricci Scalar
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8 Einstein' Field Equation

8.1 Equivalence Principle
8.2 Principle of Covariance
8.3 Lorentz Tranformation
8.4 Einstein Energy and Momentum Tensor
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New Course Proposal

Date Submitted: 01/29/18 1:25 pm

Viewing: PETE 649: Boundary Element Method for Geomechanics

Last edit: 06/15/18 9:45 am

Changes proposed by: e-schuler

Contact(s)

<table>
<thead>
<tr>
<th>Name</th>
<th>E-mail</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eleanor Schuler</td>
<td><a href="mailto:e-schuler@tamu.edu">e-schuler@tamu.edu</a></td>
<td>979-845-8402</td>
</tr>
</tbody>
</table>

Course prefix | PETE | Course number | 649 |
Department     | Petroleum Engineering |
College/School | College of Engineering |
Academic Level | Graduate |
Academic Level | Undergraduate |
Effective term | 2019-2020 |

Complete Course Title
Boundary Element Method for Geomechanics

Abbreviated Course Title
BOUND ELEM MTD GEOMECHANICS

Catalog course description
Fundamental solutions of 2D and 3D boundary element methods; formulation of 2D and 3D direct, indirect, displacement discontinuity and dual boundary element methods; development of a 2-D boundary element computer program as a student project; applications of linear constitutive relation for hard rocks; applications of linear porous fluid flow problems for petroleum engineers; application of linear elasticity problems for fracture stability and fracture propagation problems.

Prerequisites and Restrictions
Computer language such as Fortran, C, C#, C++, Matlab.

Concurrent Enrollment: No
Should catalog prerequisites/concurrent enrollment be enforced: No

Crosslistings: No

Stacked: No

Semester: 3
Credit Hour(s): 3 (per week)
Contact Hour(s): 3
Lecture: 3, Lab: 0, Other: 0
Repeatable for credit: No
Three-peat? No

CIP/Fund Code 1425010006

Default Grade Mode Letter Grade(G)

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 will be taught same as on campus

Hours Meets traditional face-to-face hours.

Describe how hours are met or provide justification why they are not met. Course will be taught same as on campus

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? Yes

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

Required (select program)

Elective (select program)

<table>
<thead>
<tr>
<th>Program(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(MS-PETE) Master of Science in Petroleum Engineering</td>
</tr>
<tr>
<td>(MEN-PETE) Master of Engineering in Petroleum Engineering</td>
</tr>
<tr>
<td>(PHD-PETE) Doctor of Philosophy in Petroleum Engineering</td>
</tr>
</tbody>
</table>

**Course Syllabus**

Syllabus: Upload syllabus

Upload syllabus PETE 649 BoundaryElement Morita Syllabus.pdf
Letters of support or other documentation: No

Additional information:

Reviewer Comments: Janet Gonzales (janet-gonzales) (06/15/18 9:45 am): Rollback: Glitch in CARS, was not "approved" to be moved to Provost II.

Reported to state?: Add

Key: 18507
Term (e.g., Fall 200X) Spring 2019
Meeting times and location TTH 11:10-12:25 PM RICH 309

Course Description and Prerequisites
Formulation and practice of the boundary element methods in solving geomechanics problems; practice borehole breakout, fracture stability and fracture propagation problems using a program to be developed by students.

Learning Outcomes
Course Description: Fundamental solutions of 2D and 3D boundary element methods; formulation of 2D and 3D direct, indirect, displacement discontinuity and dual boundary element methods; development of a 2-D boundary element computer program as a student project; applications of linear constitutive relation for hard rocks; applications of linear porous fluid flow problems for petroleum engineers; application of linear elasticity problems for fracture stability and fracture propagation problems

Prerequisites: Computer language such as Fortran, C, C#, C++, Matlab

Instructor Information
Name Nobuo Morita
Telephone number 979-458-3273
Email address Nobuo.morita@tamu.edu
Office hours By appointment
Office location 501 P Richardson Bldg

Textbook and/or Resource Material
A textbook is provided.

Grading Policies
A(100-90), B(89-80), C(79-70), D(69-60), F(59 & below)
Homework … 30%
Program coding … 30%
Final … 40%

Attendance and Make-up Policies
The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for any absence. Among the reasons absences are considered excused by the University are the following. See Student Rule 7 at http://student-rules.tamu.edu/rule07. A high score is essential for the final exam if absences are repeated.
Fundamentals
1. Fundamental elasticity equations
   (1.1) Fundamental elasticity equations
   (1.2) Boundary conditions
2. Flow through porous media
   (2.1) Fundamental equations of fluid flow through porous media
   (2.2) Boundary conditions
3. Tensor and matrix expressions
4. Fundamental solutions
   (4.1) Fundamental solutions for elasticity problems
   (4.2) Fundamental solutions for fluid flow through porous media
   (4.3) Fundamental solutions for boundary element methods for various problems.

Theoretical development
5. Boundary element methods
   (5.1) Direct boundary element method (Direct BEM)
   (5.2) Indirect boundary element method (Indirect BEM)
   (5.3) Discontinuous displacement method (DDM)
   (5.4) Dual boundary element method (Dual BEM)
   (5.5) Integral equation for poro-elasticity problems
6. Discretization of the integral equations
   (6.1) Simple discretization using elements with a constant strain
   (6.2) Strain and stress calculations within domain
   (6.3) Rigid body displacement conditions
   (6.4) Discretization using tetrahedral and eight node solid elements
   (6.5) High order elements
7. Numerical integration
   (6.1) Integration methods suitable for boundary element methods
   (6.2) Gauss integration
   (6.3) Pseudo singular integration and singular integrations
8. System of linear equations
   (8.1) Transformation from local coordinate to global coordinate
   (8.2) System of linear equations
9. Discretization of fluid flow through porous media
   (9.1) Fluid flow through porous media
   (9.2) Fundamental solution for steady state flow
   (9.3) Boundary element method for unsteady state flow through porous media

Programming
10. 2D structure code (Direct BEM) with stiffness matrix without numerical integration
   (10.1) A boundary element method for 2D elasticity problems (analytical integration of H and G matrices)
   (10.2) Stiffness matrix
   (10.3) Code example
11. 2D Structure code (Direct BEM) with stiffness matrix with numerical integration
   (11.1) Discontinuous quadratic element for 2D elasticity problems
   (11.2) Integration of stiffness matrix
11.3 Code example

12. 2D Discontinuous Boundary Element Method (DDM) suitable for crack problems
   (12.1) Analytical formulation of 2D DDM
   (12.2) Flow chart
   (12.3) Example input data for line crack problems

13. 2D boundary element method (Direct BEM) for unsteady state fluid flow problems
   (13.1) 2D boundary element method with discontinuous quadratic elements for fluid flow through porous medium
   (13.2) Flow matrix
   (13.3) Code example

14. 3D boundary element code (Direct BEM) for solid elasticity problems
   (14.1) 3D boundary element method with discontinuous quadratic element for linear elasticity problems.
   (14.2) Code example

15. 3D boundary element method (Dual BEM) for fracture stability
   (15.1) Stress intensity factor and fracture tip element
   (15.2) 3-D code for fracture problems

16. 3D fracture propagation code coupled with 2D finite element flow and 3D fracture code (DDM)

Other Pertinent Course Information

Computer usage: Require Fortran, C language or MatLab

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“An Aggie does not lie, cheat, or steal, or tolerate those who do.”
Course Change Request

New Course Proposal

Date Submitted: 01/29/18 1:29 pm

Viewing: PETE 655: Finite Element Method for Geomechanics

Last edit: 06/15/18 9:45 am
Changes proposed by: e-schuler

Contact Senate Number

<table>
<thead>
<tr>
<th>Name</th>
<th>E-mail</th>
<th>Phone</th>
</tr>
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<tbody>
<tr>
<td>Eleanor Schuler</td>
<td><a href="mailto:e-schuler@tamu.edu">e-schuler@tamu.edu</a></td>
<td>979-845-8402</td>
</tr>
</tbody>
</table>

Course prefix   PETE  
Course number  655

Department  Petroleum Engineering  
College/School College of Engineering  
Academic Level  Graduate  
Academic Level (alternate) Undergraduate  
Effective term  2019-2020

Complete Course Title  Finite Element Method for Geomechanics

Abbreviated Course Title  FINITE ELEM MTH GEOMECHANICS

Catalog course description
Formulation of the 2D and 3D finite element method; development of a simple finite element computer program; linear and non-linear constitutive relation for soft and hard rocks; applications to porous flow and geomechanics problems; code the finite element computer programs and practice to solve geomechanics problems, reservoir flow, reservoir compaction, subsidence, borehole breakout and casing stability problems.

Prerequisites and Restrictions
Computer language such as Fortran, C, C#, C++, or Matlab.

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

Semester  3  Contact Hour(s)  Lecture: 3  Lab: 0  Other: 0
Credit Hour(s) (per week):  Total
Repeatable for credit?  No
Three-peat?  No
CIP/Fund Code  1425010006

In Workflow
1. PETE Department Head
2. Curricular Services Review
3. EN Committee Preparer GR
4. EN Committee Chair GR
5. EN 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. 01/29/18 1:38 pm  Jenn-Tai Liang (jenn-tai.liang): Approved for PETE Department Head
2. 01/31/18 9:53 am  Sandra Williams (sandra-williams): Approved for Curricular Services Review
3. 02/16/18 4:59 pm  Jennifer Veracruz (jveracruz): Approved for EN Committee Preparer GR
4. 02/28/18 5:29 pm  Prasad Enje (enje): Approved for EN Committee Chair GR
5. 02/28/18 5:31 pm  Prasad Enje (enje): Approved for EN College Dean GR
6. 03/26/18 9:05 am  Meagan Kelly (meagankelly): Approved for GC Preparer
7. 04/05/18 3:26 pm  LaRhesa Johnson (lrjohnson): Approved for GC Chair
8. 04/11/18 3:28 pm  Jan Helgoth (helgoth): Approved for Faculty Senate Preparer
9. 05/15/18 4:06 pm  Janet Gonzales (janet
Default Grade Mode Letter Grade(G)
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 will be same as on campus course

Hours
Meets traditional face-to-face hours.

Describe how hours are met or provide justification why they are not met.
Course will be same as on campus course

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? Yes

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

Required (select program)

Elective (select program)

<table>
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<tr>
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<th>PETE 655 FiniteElement Morita Syllabus.pdf</th>
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<tbody>
<tr>
<td>{MEN-PETE} Master of Engineering in Petroleum Engineering</td>
<td></td>
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<tr>
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<tr>
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Course Syllabus

Syllabus: Upload syllabus

Upload syllabus PETE_655_FiniteElement_Morita_Syllabus.pdf

Letters of support or other documentation No

Additional information
Reviewer Comments

Sandra Williams (sandra-williams) (01/31/18 9:53 am): Edits made to catalog course description to conform to catalog style guide.

Janet Gonzales (janet-gonzales) (06/15/18 9:45 am): Rollback: Glitch in CARS, was not "approved" to be moved to Provost II.

Reported to state?

Add
Term (e.g., Fall 200X)        Spring 2020
Meeting times and location   TTH 12:40 – 2:00 PM  RICH 309

Course Description and Prerequisites
Formulation and practice of the finite element method in solving geomechanics and pore flow problems; practice 3D transient fluid flow around perforations, 3D oil reservoir formation stability during production and fluid injection, borehole breakout and casing stability problems using a program to be developed by students.

Learning Outcomes
Course Description: Formulation of the 2D and 3D finite element method; development of a simple finite element computer program as a student project; linear and non-linear constitutive relation for soft and hard rocks; applications to porous flow and geomechanics problems. Students learn how to code the finite element computer programs. Using the code, student practice to solve geomechanics problems, reservoir flow, reservoir compaction, subsidence, borehole breakout and casing stability problems.

Prerequisites: Computer language such as Fortran, C, C#, C++, or Matlab

Instructor Information
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Office location            501 P Richardson Bldg

Textbook and/or Resource Material
A textbook is provided.

Grading Policies
A(100-90), B(89-80), C(79-70), D(69-60), F(59 & below)
Homework … 30%
Program coding … 30%
Final … 40%

Attendance and Make-up Policies
The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for any absence. Among the reasons absences are considered excused by the University are the following. See Student Rule 7 at http://student-rules.tamu.edu/rule07. A high score is essential for the final exam if absences are repeated.
Course Topics, Calendar of Activities, Major Assignment Dates

Part 1 Basics of the finite element method
1. Fundamental equations of poro-elasticity and fluid flow through porous media
   (1.1) Force, displacement, stress-strain and displacement-strain relation
   (1.2) Equation of equilibrium and stress strain relation
   (1.3) Fluid flow through porous media
   (1.4) Matrix expression
2. Finite element methods
   (2.1) Discretization using the virtual work principle
   (2.2) Discretization using the minimization of total potential energy
   (2.3) Discretization using the residual method
   (2.4) Discretization of the set of flow equations through porous media using the residual method
3. Finite element method with analytical integration using simple elements
   (3.1) Discretization using 3D tetrahedral elements
   (3.2) Analytical integrations
   (3.3) Assembling the elements
   (3.4) Nodal forces
   (3.5) Body forces
4. Finite element method with isoparametric elements
   (4.1) Isoparametric elements
   (4.2) Brick elements
5. Numerical integration
   (5.1) Gaussian integration
   (5.2) Integration formula for triangle and tetrahedron shape functions
6. Solution of linear simultaneous equations
   (6.1) Matrix transformation for the boundary condition given by local coordinates
   (6.2) Solution of linear simultaneous equations
7. Convergence and error analysis
8. Application of the finite element method to non-linear geological materials
   (8.1) Non-linear problems
   (8.2) Application of the Newton-Raphson method to non-linear problems
   (8.3) Calculation method of $\lambda$ and $D_{ep}$
   (8.4) Implementation
9. Coupling problems for fluid flow through geomechanics structure
   (9.1) Fundamental equation
   (9.2) Discretization using the virtual work principle
   (9.3) Discretization of fluid flow through porous media
   (9.4) Coupling
   (9.5) Apparent elastic moduli with pore fluid
   (9.6) Accelerating the convergence for sequential coupling
   (9.7) Coupling for non-linear problems
   (9.8) Sequential coupling of a geomechanics model and a reservoir without modifications of both models
Part 2 Applications of the finite element method
10. Pressure profile around perforations
11. Numerical evaluation of gravel pack damage
12. Realistic on-set of sand-production prediction: numerical approach
13. Sand rate model for gas and light oil
14. Numerical methods for the borehole breakout problems
15. Casing collapse problems for hydrostatic and geotechnical loads

Part 3 Pragraming of the finite element method
2D and 3D finite element code for single phase transient porous fluid flow problems
Geo3D code

Other Pertinent Course Information

Computer usage: Require Fortran or C language

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
"An Aggie does not lie, cheat, or steal, or tolerate those who do."

Americans with Disabilities Act (ADA)