Petroleum Engineering 631 — Petroleum Reservoir Description
Syllabus and Administrative Procedures
Spring 2012

Instructor:

Instructor: Dr. Tom Blasingame
Office: RICH 821
Lecture: *MWF 19:00-20:15 RICH 313
Office Hours: Please use e-mail — t-blasingame@tamu.edu

* This will primarily be a remote-learning course, we will only meet infrequently and I will notify you of dates for course meetings. All lectures will be recorded and archived. We will only meet for class when you are notified in writing by the Instructor (i.e., you will be notified by e-mail if we are meet in class on a given date) — do not attend class unless you are instructed to do so.

Texts:
At present, there is no comprehensive text for this course — we will use journal articles, conference papers, and presentations — as well as other materials which support the topics considered in the course.

Reference Materials:
1. Course materials for this semester are located at:
   http://www.pe.tamu.edu/blasingame/data/P631_12A/
2. Various articles/presentations/etc. (to be made available in electronic formats)

Basis for Grade:
Homework/Projects/Presentations ................................................................. 90%
Participation (timeliness, demonstrated interest, etc.) ........................................ 10%
total = 100%

Grade Cutoffs: (Percentages)
A: > 90    B: 89.99 to 80    C: 79.99 to 70    D: 69.99 to 60   F: < 59.99

Policies and Procedures:
1. Students are expected to keep pace in the course — PLEASE DO NOT FALL BEHIND IN THE LECTURES OR YOUR ASSIGNMENTS.
2. Policy on Grading
   a. Coursework is graded on the basis of answers — partial credit is at the discretion of the instructor.
   b. All work requiring calculations shall be properly and completely documented for credit.
   c. Grading will be performed by the instructor, or under his supervision — instructor's grading is final.
3. Policy on Re-grading
   a. Work will very rarely be considered for re-grading — partial credit (if any) is not subject to appeal.
   b. Work which, while possibly correct, but cannot be followed, will be considered incorrect.
   c. Grades assigned to homework problems will not be considered for re-grading.
   d. If re-grading is necessary, the student is to submit a letter to the instructor explaining the situation that requires consideration for re-grading, the material to be re-graded must be attached to this letter. The letter and attached material must be received within one week from the date returned by the instructor.
4. The grade for a late assignment is zero. Homework will be considered late if it is not turned in at the start of class on the due date. If a student comes to class after homework has been turned in and after class has begun, the student's homework will be considered late and given a grade of zero. Late or not, all assignments must be turned in. A course grade of Incomplete will be given if any assignment is missing, and this grade will be changed only after all required work has been submitted.
5. Each student should review the University Regulations concerning attendance, grades, and scholastic dishonesty. In particular, anyone caught cheating on an examination or collaborating on an assignment where collaboration is not specifically authorized by the instructor will be removed from the class roster and given an F (failure grade) in the course.
Course Description:

*Graduate Catalog:* Engineering and geological evaluation techniques to define the extent and internal character of a petroleum reservoir; estimate depositional environment(s) during the formation of the sedimentary section and resulting effects on reservoir character.

*Translation:* Focus on geology and petrophysics that can be tied to the "Engineering aspects" of reservoir modeling. This course is a "prequel" to a course on Reservoir Engineering Aspects of Unconventional Reservoirs to be offered later in 2012. The focus of this course will be the historical components of conventional and unconventional reservoirs (including tight gas sands) that have led to the present emphasis on "unconventional" reservoirs — primarily gas shales and liquids-rich shale reservoir systems.

**Prerequisites:** Approval of Instructor.

**Course Objectives:** (as of 17 January 2012)

- **Geology:**
  - Basic Concepts and Sedimentary Processes.
  - Depositional Environments (sandstone/elastic, carbonate, and shale/source rock reservoir systems).
  - Conditions for the generation of oil and natural gas.

- **Petrophysics:**
  - Classical relationships (Archie relations, log(k) versus ϕ plot, petrophysics process workflows).
  - Modern assessment (thin sections, power law correlations of porosity and permeability data, etc.).
  - k-ϕ correlations (application of a modified power law correlation to low permeability data).

- **Non-Laminar/Non-Darcy Flow Behavior:**
  - Forchheimer relation for high velocity flow.
  - Klinkenberg concept for gas-slippage.
  - Modern fluid mechanics (Knudsen Flow).

- **Effect of Clays (Shale) on Flow Behavior:**
  - Origin, distribution, and digenesis of clay materials.
  - Correlation of clay type with rock properties (k, ϕ) and rock fluid properties (p_r, k_r).
  - Clay type and distribution influence on production performance.

- **Geologic Character of Tight Gas/Shale Gas Reservoirs:** (focus on North America)
  - Tight Gas Reservoirs (concept model used for last 30 years has been repeatedly validated (water over gas)).
  - Shale Gas Reservoirs (basin-centered gas reservoirs — high temperatures and pressures, heterogeneous).
  - Capillarity Influence (modern proposal is that capillarity can dominate fluid flow behavior in-situ).

- **Integrated Reservoir Description Processes for Low/Ultra-Low Permeability Reservoir Systems:**
  - Petrophysics Focus (Gunter, et al process emphasizes geological and petrophysical data).
  - Characterization Focus (Rushing/Newsham process adds emphasis on reservoir performance and modeling).
  - Reservoir Scale Effects (Atto/nano/micro/macro/mega/giga-scale comparisons, average-volume modeling).

- **Performance of Tight Gas and Gas Shales/Liquids-Rich Shale Reservoirs:** (Time-Rate-Pressure Analysis)
  - Vertical Wells (presumed elliptical flow geometry somewhat validated using historical data)
  - Horizontal Multi-Fractured Wells (complex analytical/numerical models)

- **Reserves Estimation of Gas Shale/Liquids-Rich Shale Reservoirs:** (Time-Rate Analysis)
  - Traditional rate-time analyses (e.g., decline curve analysis).
  - Advanced rate-time models (Stretched Exponential, Power-Law Exponential, Duong Model, etc.).
  - Continuous EUR method.
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<td>January 17</td>
<td>Course Introduction</td>
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<tr>
<td>January 19</td>
<td>[Geology] Basic Concepts and Sedimentary Processes</td>
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<td>January 24</td>
<td>[Geology] Depositional Environments (Sandstone/Clastics, Carbonate, Shales)</td>
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<td>January 26</td>
<td>[Geology] Conditions For the Generation of Oil And Natural Gas</td>
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<td>February 02</td>
<td>[Petrophysics] Modern Assessment (Thin Sections, Correlations of Porosity/Permeability, etc.)</td>
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<td>February 07</td>
<td>[Petrophysics] $k$-$\phi$ Correlations (application of a modified power law correlation)</td>
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<td>February 09</td>
<td>[Non-Laminar/Non-Darcy Flow] Forchheimer Relation For High Velocity Flow</td>
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<td>February 14</td>
<td>[Non-Laminar/Non-Darcy Flow] Klinkenberg Concept For Gas-Slippage</td>
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<td>February 16</td>
<td>[Non-Laminar/Non-Darcy Flow] Modern Fluid Mechanics (Knudsen Flow)</td>
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<td>February 21</td>
<td>[Effect of Clays (Shale)] Origin, Distribution, And Digenesis Of Clay Materials</td>
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<td>February 23</td>
<td>[Effect of Clays (Shale)] Correlation Of Clay Type With Rock/Fluid-Fluid Properties</td>
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<td>February 28</td>
<td>[Effect of Clays (Shale)] Clay Type and Distribution Influence on Production Performance</td>
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<td>March 01</td>
<td>[Geology — Tight Gas/Shales] Tight Gas Reservoirs</td>
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<td>March 06</td>
<td>[Geology — Tight Gas/Shales] Shale Gas Reservoirs</td>
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<td>March 08</td>
<td>[Geology — Tight Gas/Shales] Capillarity Influence</td>
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<td>March 20</td>
<td>[Integrated Reservoir Description] Petrophysics Focus (Gunter, et al process)</td>
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<td>March 22</td>
<td>[Integrated Reservoir Description] Characterization Focus (Rushing/Newsham process)</td>
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<td>March 27</td>
<td>[Integrated Reservoir Description] Reservoir Scale Effects, Average-Volume Models</td>
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<td>[Performance of Tight Gas/Shales] Vertical Wells — Introduction</td>
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<td>April 03</td>
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<td>April 10</td>
<td>[Performance of Tight Gas/Shales] Horizontal Wells — Introduction</td>
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<td>April 12</td>
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<td>April 17</td>
<td>[Performance of Tight Gas/Shales] Horizontal Wells — Production Analysis</td>
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<td>April 19</td>
<td>[Reserves Estimation] Traditional Rate-Time Analyses</td>
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<td>April 24</td>
<td>[Reserves Estimation] Advanced Rate-Time Models</td>
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<td>April 26</td>
<td>[Reserves Estimation] Continuous EUR Method</td>
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<td>May 01</td>
<td>Course Closure</td>
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<td>May 03</td>
<td>Reading day, no classes</td>
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<td>May 08</td>
<td>Final Exam/Project is due by 17:00 (5:00 p.m.) for classes held TR 7:05-8:20 p.m. (<a href="http://registrar.tamu.edu/General/FinalSchedule.aspx#_Spring_2012">http://registrar.tamu.edu/General/FinalSchedule.aspx#_Spring_2012</a>)</td>
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**Note:** Dates in green are tentative physical class meeting dates, but do NOT attend class unless you are notified in writing *(i.e., via e-mail)* that class will physically meet on a particular date.
Americans with Disabilities Act (ADA) Statement:
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 Department of Student Life, Services for Students with Disabilities in Room B118 of Cain Hall, or call 845-1637.

Aggie Honor Code: (http://www.tamu.edu/aggiehonor/)

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

Definitions of Academic Misconduct:
1. CHEATING: Intentionally using or attempting to use unauthorized materials, information, notes, study aids or other devices or materials in any academic exercise.
2. FABRICATION: Making up data or results, and recording or reporting them; submitting fabricated documents.
3. FALSIFICATION: Manipulating research materials, equipment or processes, or changing or omitting data or results such that the research is not accurately represented in the research record.
4. MULTIPLE SUBMISSION: Submitting substantial portions of the same work (including oral reports) for credit more than once without authorization from the instructor of the class for which the student submits the work.
5. PLAGIARISM: The appropriation of another person's ideas, processes, results, or words without giving appropriate credit.
6. COMPLICITY: Intentionally or knowingly helping, or attempting to help, another to commit an act of academic dishonesty.
7. ABUSE AND MISUSE OF ACCESS AND UNAUTHORIZED ACCESS: Students may not abuse or misuse computer access or gain unauthorized access to information in any academic exercise. See Student Rule 22: http://student-rules.tamu.edu/
8. VIOLATION OF DEPARTMENTAL OR COLLEGE RULES: Students may not violate any announced departmental or college rule relating to academic matters.
9. UNIVERSITY RULES ON RESEARCH: Students involved in conducting research and/or scholarly activities at Texas A&M University must also adhere to standards set forth in the University Rules.

For additional information please see:
http://student-rules.tamu.edu/.

Coursework Copyright Statement: (Texas A&M University Policy Statement)
The handouts used in this course are copyrighted. By "handouts," this means all materials generated for this class, which include but are not limited to syllabi, quizzes, exams, lab problems, in-class materials, review sheets, and additional problem sets. Because these materials are copyrighted, you do not have the right to copy them, unless you are expressly granted permission.

As commonly defined, plagiarism consists of passing off as one’s own the ideas, words, writings, etc., that belong to another. In accordance with this definition, you are committing plagiarism if you copy the work of another person and turn it in as your own, even if you should have the permission of that person. Plagiarism is one of the worst academic sins, for the plagiarist destroys the trust among colleagues without which research cannot be safely communicated.

If you have any questions about plagiarism and/or copying, please consult the latest issue of the Texas A&M University Student Rules, under the section "Scholastic Dishonesty."
Assignment Coversheet

[This sheet (or the sheet provided for a given assignment) must be included with EACH work submission]

Required Academic Integrity Statement: (Texas A&M University Policy Statement)

Academic Integrity Statement

All syllabi shall contain a section that states the Aggie Honor Code and refers the student to the Honor Council Rules and Procedures on the web.

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 shall be preprinted and signed by the student:

"On my honor, as an Aggie, I have neither given nor received unauthorized aid on this academic work."

Aggie Code of Honor:

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

Required Academic Integrity Statement:

"On my honor, as an Aggie, I have neither given nor received unauthorized aid on this academic work."

________________________________________ (Print your name)

________________________________________ (Your signature)