



**Course** GEOS5373 -001 Physical properties of rocks  
**Professor** George McMechan  
**Term** Spring 2008  
**Meetings** Tuesday 2:30-5:15 WT2.212

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### **Professor's Contact Information**

**Office Phone** 972-883-2419  
**Other Phone**  
**Office Location** WT2.204  
**Email Address** mcmec@utdallas.edu  
**Office Hours** Wednesday 2:00 – 3:00 or by appointment  
**Other Information**

### **General Course Information**

**Pre-requisites, Co-requisites, & other restrictions** completion of the undergraduate Geosciences math and physics requirements.

### **Course Description**

This course provides an understanding of the physical phenomena and processes that determine properties of rocks and soils. Topics include porosity and permeability; surface energy, roughness, and adsorption; percolation, fractures and heterogeneous media; problems of scale; mechanical behavior of dry and fluid saturated rocks; elasticity, viscoelasticity, and plasticity; acoustic, electric, dielectric, thermal, and magnetic properties. The approach is practical, with emphasis on understanding why rocks behave as they do, and how simple physical principles can be used to predict rock and soil properties under various conditions.

Suitable for graduate students in any branch of geosciences who wish to obtain a broad introduction to physical properties as they pertain to lab and field measurements, and are applied to reservoir, engineering, and environmental problems.

Class examples are designed to develop understanding through applications of the lecture material.

**Learning Outcomes** Goals of the course include building student's skills in interpretation of the earth's structure and processes, demonstrating technical expertise in analysis and evaluation of the relations between measurements and rock properties, and between different

rock properties. Includes becoming familiar with the current research literature.

- Required Texts & Materials**
- Introduction to the Physics of Rocks  
Yves Gueguen and Victor Palciauskas (1994)  
Princeton University Press, Princeton, NJ  
QE431.5.G8413  
ISBN 0-691-03452-4
- Suggested Texts, Readings, & Materials**
- 1) PHYSICAL PROPERTIES OF ROCKS AND MINERALS  
Y.S. Touloukian and C.Y. Ho (Editors) (1981)  
McGraw-Hill/CINDAS Data Series on Material Properties  
QE431.6.P5P48  
ISBN 0-07-065032-2
  - 2) HANDBOOK OF PHYSICAL CONSTANTS  
S.P. Clark (Editor) 1966  
The Geological Society of America, Memoir 97  
Library of Congress # 66-19814
  - 3) HANDBOOK OF PHYSICAL PROPERTIES OF ROCKS,  
VOLS 1, 2 & 3  
R.S. Carmichael (Editor) 1982  
CRC Press, Inc.  
QE431.6.P5C18  
ISBN 0-8493-0226-9
  - 4) ELECTROMAGNETIC METHODS IN APPLIED  
GEOPHYSICS - THEORY  
M.S. Nabighian (Editor) 1987  
Society of Exploration Geophysicists  
ISBN 0-931830-51-6  
Library of Congress # 87-06330
  - 5) ACOUSTICS OF POROUS MEDIA  
T. Bourbie, O. Coussy, and B. Zinszner (1987)  
Gulf Publishing Co.  
ISBN 0-87201-025-2  
Library of Congress # 86-82913
  - 6) DIELECTRICS AND WAVES  
A. R. von Hippel (1954)

The M.I.T. Press  
Library of Congress # 54-11020

7) PHYSICAL PROPERTIES OF ROCKS

J.H. Schon (1996)  
Elsevier Science Ltd.  
ISBN 0 08 04 10081

8) THE ROCK PHYSICS HANDBOOK

Mavko, Mukerji and Dvorkin (1998)  
Cambridge University Press  
ISBN 0 521 62068 6

9) POROUS MEDIA - FLUID TRANSPORT AND PORE  
STRUCTURE

F.A.L. Dullen (1991)  
Academic Press  
QC175.2D84  
ISBN 0-12-223651-3

10) DEVELOPMENTS IN PETROPHYSICS

M.A. Lovell and P.K. Harvey (Editors) (1997)  
The Geological Society, London  
ISBN 1-897799- 81-0

**Assignments & Academic Calendar**

*[Topics, Reading Assignments, Due Dates, Exam Dates]*

**Insert Week Number**

**OR Range of Dates  
for week**

Jan	08	Physical classification of rocks, processes Porous media, porosity, porosity evolution
Jan	15	Surface energy, imbibition & drainage, adsorption, roughness
Jan	22	heterogeneity, scales, effective media, percolation, fractures
Jan	29	mechanical properties of dry rocks, stress & strain, deformation, elasticity
Feb	05	fracture, plasticity
Feb	12	fluid circulation, permeability models
Feb	19	mechanical properties of saturated rocks, poroelasticity, fractures, plasticity
Feb	26	acoustic properties, attenuation, anisotropy
March	04	NO CLASS (GO TO THE CONSORTIUM MEETING)
March	11	NO CLASS (MID-TERM BREAK)
March	18	QUIZ # 1 acoustic properties, attenuation, anisotropy

March 25 electrical conductivity, models  
 April 01 dielectric properties, polarization, EM waves  
 April 08 dielectric properties of rocks  
 April 15 thermal conductivity of minerals & rocks  
 April 22 magnetic properties of mineral & rocks  
 April 29 pre-test review  
 May 06 QUIZ # 2

**Insert Exam Date(s),**  
**Time(s)** See above class schedule

**Course Policies**

<b>Grading (credit) Criteria</b>	<b>Grades will be based on two exams (50% each)</b>
<b>Make-up Exams</b>	<b>Only for legitimate non-academic reasons</b>
<b>Extra Credit</b>	<b>none</b>
<b>Late Work</b>	
<b>Special Assignments</b>	<b>none</b>
<b>Class Attendance</b>	<b>Expected, but not mandatory (at student's risk of not understanding and not having an opportunity to ask questions for clarification in class)</b>
<b>Classroom Citizenship</b>	<b>Civil interaction is expected</b>
<b>Field Trip Policies Off-Campus Instruction &amp;</b>	<i>Off-campus, out-of-state, and foreign instruction and activities are subject to state law and University policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at the website address <a href="http://www.utdallas.edu/BusinessAffairs/Travel_Risk_Activities.htm">http://www.utdallas.edu/BusinessAffairs/Travel_Risk_Activities.htm</a>. Additional information is available from the office of the school dean. Below is a</i>

<b>Course Activities</b>	<i>description of any travel and/or risk-related activity associated with this course.</i>
<b>Technical Support</b>	If you experience any problems with your UTD account you may send an email to: <a href="mailto:assist@utdallas.edu">assist@utdallas.edu</a> or call the UTD Computer Helpdesk at 972-883-2911.
<b>Student Conduct and Discipline</b>	<p>The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UTD printed publication, <i>A to Z Guide</i>, which is provided to all registered students each academic year.</p> <p>The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the <i>Rules and Regulations, Series 50000, Board of Regents, The University of Texas System</i>, and in Title V, Rules on Student Services and Activities of the university's <i>Handbook of Operating Procedures</i>. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/883-6391) and online at <a href="http://www.utdallas.edu/judicialaffairs/UTDJudicialAffairs-HOPV.html">http://www.utdallas.edu/judicialaffairs/UTDJudicialAffairs-HOPV.html</a></p> <p>A student at the university neither loses the rights nor escapes the responsibilities of citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.</p>
<b>Academic Integrity</b>	<p>The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work.</p> <p>Scholastic Dishonesty, any student who commits an act of scholastic dishonesty is subject to discipline. Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts.</p> <p>Plagiarism, especially from the web, from portions of papers for other classes, and from any other source is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details). This course will use the</p>

	resources of turnitin.com, which searches the web for possible plagiarism and is over 90% effective.
<b>Copyright Notice</b>	<p>The copyright law of the United States (Title 17, United States Code) governs the making of photocopies or other reproductions of copyrighted materials, including music and software. Copying, displaying, reproducing, or distributing copyrighted works may infringe the copyright owner's rights and such infringement is subject to appropriate disciplinary action as well as criminal penalties provided by federal law. Usage of such material is only appropriate when that usage constitutes "fair use" under the Copyright Act. As a UT Dallas student, you are required to follow the institution's copyright policy (Policy Memorandum 84-I.3-46). For more information about the fair use exemption, see <a href="http://www.utsystem.edu/ogc/intellectualproperty/copypol2.htm">http://www.utsystem.edu/ogc/intellectualproperty/copypol2.htm</a></p>
<b>Email Use</b>	<p>The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. The university encourages all official student email correspondence be sent only to a student's U.T. Dallas email address and that faculty and staff consider email from students official only if it originates from a UTD student account. This allows the university to maintain a high degree of confidence in the identity of all individual corresponding and the security of the transmitted information. UTD furnishes each student with a free email account that is to be used in all communication with university personnel. The Department of Information Resources at U.T. Dallas provides a method for students to have their U.T. Dallas mail forwarded to other accounts.</p>
<b>Withdrawal from Class</b>	<p>The administration of this institution has set deadlines for withdrawal of any college-level courses. These dates and times are published in that semester's course catalog. Administration procedures must be followed. It is the student's responsibility to handle withdrawal requirements from any class. In other words, I cannot drop or withdraw any student. You must do the proper paperwork to ensure that you will not receive a final grade of "F" in a course if you choose not to attend the class once you are enrolled.</p>
<b>Student Grievance Procedures</b>	<p>Procedures for student grievances are found in Title V, Rules on Student Services and Activities, of the university's <i>Handbook of Operating Procedures</i>.</p> <p>In attempting to resolve any student grievance regarding grades, evaluations, or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originates (hereafter called "the respondent"). Individual faculty members retain primary responsibility for assigning grades and evaluations. If the matter cannot be resolved at that level, the grievance must be submitted in writing to the respondent with a copy of the respondent's School Dean. If the matter is not resolved by the written response provided by the respondent, the</p>

	<p>student may submit a written appeal to the School Dean. If the grievance is not resolved by the School Dean's decision, the student may make a written appeal to the Dean of Graduate or Undergraduate Education, and the dean will appoint and convene an Academic Appeals Panel. The decision of the Academic Appeals Panel is final. The results of the academic appeals process will be distributed to all involved parties.</p> <p>Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations.</p>
<b>Incomplete Grades</b>	<p>As per university policy, incomplete grades will be granted only for work unavoidably missed at the semester's end and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight (8) weeks from the first day of the subsequent long semester. If the required work to complete the course and to remove the incomplete grade is not submitted by the specified deadline, the incomplete grade is changed automatically to a grade of <b>F</b>.</p>
<b>Disability Services</b>	<p>The goal of Disability Services is to provide students with disabilities educational opportunities equal to those of their non-disabled peers. Disability Services is located in room 1.610 in the Student Union. Office hours are Monday and Thursday, 8:30 a.m. to 6:30 p.m.; Tuesday and Wednesday, 8:30 a.m. to 7:30 p.m.; and Friday, 8:30 a.m. to 5:30 p.m.</p> <p>The contact information for the Office of Disability Services is:  The University of Texas at Dallas, SU 22  PO Box 830688  Richardson, Texas 75083-0688  (972) 883-2098 (voice or TTY)  <a href="mailto:disabilityservice@utdallas.edu">disabilityservice@utdallas.edu</a></p> <p>If you anticipate issues related to the format or requirements of this course, please meet with the Coordinator of Disability Services. The Coordinator is available to discuss ways to ensure your full participation in the course. If you determine that formal, disability-related accommodations are necessary, it is very important that you be registered with Disability Services to notify them of your eligibility for reasonable accommodations. Disability Services can then plan how best to coordinate your accommodations.</p> <p>It is the student's responsibility to notify his or her professors of the need for such an accommodation. Disability Services provides students with letters to present to faculty members to verify that the student has a disability and needs accommodations. Individuals requiring special accommodation should contact the professor after class or during office hours.</p>
<b>Religious Holy Days</b>	<p>The University of Texas at Dallas will excuse a student from class or other required activities for the travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, Tax Code,</p>

Texas Code Annotated.

The student is encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment. The student, so excused, will be allowed to take the exam or complete the assignment within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment.

If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the chief executive officer of the institution, or his or her designee. The chief executive officer or designee must take into account the legislative intent of TEC 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee.

***These descriptions and timelines are subject to change at the discretion of the Professor.***