DR. JANUSZ GREBOWICZ / MY WEBSITE

THERMOPHYSICAL PROPERTIES OF MATERIALS

course syllabus / spring 2023 / lecture & lab / credits: 4

PHYS 3402 / CHEM 3402

(23128 / 23129 / 23144 / 25341)

CST STATEMENT. College of Sciences & Technology (CST) stands in solidarity with all our fellow Americans in their call for racial justice, exercising the First Amendment right guaranteeing freedom of expression and freedom of assembly to hold our government power accountable.

BASIC RULES IN MY CLASS. Critical thinking is a chosen strategy in my class as the way of collecting, analyzing observed data and coming out with the right conclusion. UHD is a historically Hispanic-serving university with one of the most diverse student bodies in the U.S. As a UHD professor and a Fulbright Scholar I actively promote diversity, equality, inclusiveness, and antiracism—the values dear to me, my university, and the Fulbright Program.

MY TEACHING PHILOSOPHY TOWARD YOUR SUCCESS. This course is heavy with real life experimental observations/measurements. Understanding and explanation of phenomena is critical for drawing the right conclusions. Important step in this process is the use of analytical formulas, which are necessary to give quantitative evaluation of the observed phenomenon as we see it today. Using the formula, one can also predict the effect in the future, and get information about the past events. My goal for this course is that you understand clearly the topics discussed (the phenomena), and you communicate your understanding to me through reports and presentation. This is how I understand your success in my class.

When it comes to study, I encourage group work as alternative to individual studies. In case your learning process encounters problems, please do not hesitate to contact me, particularly in person. You are welcome to enter my office anytime you see my door open.

There is no full university experience without scientific research. After completion of the course, I encourage you to visit my world class Thermal Analysis Laboratory and learn about experimental work we perform within 3300 Physics Research. Research experience is very enriching for your understanding of Physics you enquire in this lecture. It also enriches your CV greatly. Your research at my lab will have international reach: I cooperate with many renown researchers from European universities, which opens doors for you to participate in 5-weeks Summer Research Semester there, publish papers in respected international journals and gain professional experience highly valued on a job market.

For many of my former students both Thermal Properties and Physics Research where decisive factors that landed them jobs at major companies like Exxon, Shell or BP or paved their way to PhD studies at reputable schools. Recently one of my students, Christina, performed research with me, which was so substantial that it subsequently turned out to be major portion of her PhD thesis, although UHD does not even offer Physics major! I strongly encourage you to come work with us and get advantage of this unique opportunity.

PREREQUISITES: PHYS 1308 or PHYS 2402. *Any chemistry is a plus.*

INSTRUCTOR: DR. JANUSZ GREBOWICZ / MY WEBSITE

Natural Sciences Department, UHD / Office: S-812 / Phone: 713-221-2756 / grebowiczj@uhd.edu
(under normal circumstances, I will respond to your question within 48 hours, usually much earlier)

Class: Tu 1:00PM–2:15PM and Th 2:30PM–5:15PM, face-to-face
Room: Tu ACAD A632 (lecture), Th OMB S812A (laboratory)
Office Hours: Tu 4:30PM-5:30PM + anytime I am in my office the door is open for you

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From: Bell, Hope / Sent: April 28, 2017, 8:05 AM / To: Grebowicz, Janusz / Subject: greetings

Hello Professor Grebowicz,
I am towards the end of my internship at BP and wanted to let you know how thankful I still am towards the experience I had in your class. The lab experience helped me land the position and the presentation you had assigned is helping me now in my final week of my internship. I have had two presentations already and will have one final formal one for the end of my internship. This presentation will help seal the deal for a full-time position. If you had not assigned us a presentation, I wouldn't have had a chance to force myself out of my comfort zone. Also, the topic of unconventional drilling methods was a very useful discussion I had in your class. I am very appreciative of your class and wanted to say thank you again! As for my experience here I have learned a lot! BP is a large company and there is so many teams I have been able to engage with. This includes explorations geologists and geophysicists, reservoir development geologists and geophysicists, engineers, bio-stratigraphers, micro paleontologists, and the list goes on.

I hope all is well with you and I hope you have had a great semester.
Sincerely, your former student,
Hope Bell

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From: michael young / Sent: August 2, 2022, 5:59 PM / To: Grebowicz, Janusz / Subject: 2nd world geoscientists

Good evening Dr. Grebowicz,
I am a former student of yours. You helped inspire me to do well in physics, which was a fundamental part of the competition I was in. The Imperial Barrel award is the largest international oil competition in the world, seeing participation from over 600 universities. My team won all of North America, then placed 2nd in the world in front of titans in the industry.

Michael Young

COURSE DESCRIPTION:

Discussion of phase structure and transitions in materials occurring with changing temperature involving both lecture instruction as well as hands on laboratory experience. Materials studied are polymers, liquid crystals, and geological materials.

This course combines lecture and lab activities. It is broken down into two major parts:

a. In the initial phase of the semester students will be learning the basics of six thermal analysis techniques: Differential Scanning Calorimetry, Thermogravimetry, Dilatometry, Mass Spectrometry, Polarized Optical Microscopy, and Small Angle Laser Light Scattering. The lab exercises will be utilizing Poly(ethylene terephthalate) (PET), Poly(trimethylene terephthalate) (PTT) and Polypropylene (PP) as model compounds.

b. In the second part of the semester students will be assigned research projects using sample materials provided by the instructor. In the case the student is engaged in research activities with particular Professor in their major, they may study the material from that project in this course. One of the goals of the laboratory is frequent seminar type discussions of results obtained by the students. Students will be assigned two reports: a midterm (written text) and a final (poster). In addition, each student will be required to give an oral presentation, 15 minutes long. The course will conclude with a lecture on Research Ethics. Students are encouraged to bring in their own materials, obtained/used during their other research projects, so that those may be introduced to our study process.

LEARNING OBJECTIVES / COURSE LEARNING OUTCOMES:

Upon completion of this course the student is expected to know basics of six thermal analysis techniques: Differential Scanning Calorimetry, Thermogravimetry, Dilatometry, Mass Spectrometry, Polarized Optical Microscopy, and Small Angle Laser Light Scattering. The student will master operation of all analytical instruments both as stand-alone and as combined techniques. By the end of the course the student will be able to perform thermal analysis of the material to give quantitative description of the phase structure, morphology, phase transitions, thermal stability, and decomposition pattern and present these in writing in the format of journal article. All lab exercises are modeled after real life thermoanalytical activities in an industrial research and technology environment.

REQUIRED READING:

Textbook: No specific textbook is assigned. Handouts on specific topics will be distributed on an as-needed basis prior to the laboratory activity. Online literature search will be necessary during this course.

Recommended reading:

- Joseph Menczel, Janusz Grebowicz, The Handbook of Differential Scanning Calorimetry, Elsevier, 2022 https://www.elsevier.com/books/the-handbook-of-differential-scanning-calorimetry/menczel/978-0-12-811347-9
- Bernhard Wunderlich, Thermal Analysis https://www.amazon.com/Bernhard-Wunderlich/e/B001HPANRC

- Bernhard Wunderlich, Thermal Analysis of Polymeric Materials https://www.amazon.com/Bernhard-Wunderlich/e/B001HPANRC
- Joseph D. Menczel and R. Bruce Prime, *Thermal Analysis of Polymers*, Wiley 2009
- Vincent B.F. Mathot, Calorimetry and Thermal Analysis of Polymers, Hansen, 1993
- Blaine/Schoff editors, *Purity Determinations by Thermal Methods*, ASTM STP, 1984

TOPICS TO BE COVERED / RESEARCH AREA:

Part One: lecture

LECTURE: BASICS OF THERMAL ANALYSIS

- Thermogravimetric Analysis (TGA)
- Differential Scanning Calorimetry (DSC)
- Thermomechanical Analysis (TMA)
- Mass Spectrometry (MS)
- Polarization of light and Polarizing Microscopy
- Scattering of (laser) light at small angles (SALS)

Lecture material:

- Basics of Thermal Analysis
- Characterization of materials based on their thermal properties:
  a. Polymers
  b. Mesophase materials / liquid crystals / condis crystals
  c. Oil shales
  d. Geopolymers
  e. Other geological materials (student recommendations welcome)

Part Two: laboratory

The objective: To acquire theoretical knowledge and practical skills to characterize thermal properties of Poly(ethylene terephthalate) (PET), Poly(trimethylene terephthalate (PTT) and Polypropylene(PP) and geological materials using variety of thermoanalytical techniques.

A. LABORATORY PROJECT 1

Project title: *"Phase structure and properties of materials as a function of processing conditions"*

Lab activities:

- Determination of upper temperature range for the experiment using TGA/DSC/MS.
- Compression molding of Polyester film (PET, PTT)
- Morphology by Optical Microscopy
- Morphology by Small Angle Laser Light Scattering
- Phase structure and transitions by DSC
- PET fibers

Midterm lab report due February 28 (~15 pages).

B. LABORATORY PROJECT 2
Project title: *"Thermal properties of oil/gas shales"*

Lab activities:

- Application of simultaneous TGA/DTA/MS (STA) to a series of oil/gas shale samples
- Thermal expansion of shales and its anisotropy by TMA at sub ambient and high temperatures.

Final lab report or poster (depending on course dynamics) due May 3 (~15 pages).

MAJOR ASSIGNMENTS / GRADING POLICY:

1.Two lab reports:

a. Midterm (~15 pages). The report must be in the format of journal article.
b. Final report / poster to be presented at Student Research Conference at UHD.

2.Each student will be required to give 15 min. oral presentation on the topic of research.

The final grade will be computed as follows:

35 percent of the midterm report
30 percent of the oral presentation (topics and dates to be assigned by the Professor)
35 percent of the written final report

Grade earned: 90% A, 80% B, 70% C, 60% D, <60% F

UNIVERSITY POLICIES AND PROCEDURES PROVIDED BY THE OFFICE OF THE PROVOST:

In addition to the policies specified in this course syllabus, all UHD courses also follow shared policies published on the syllabus website addressing the following areas:

- Responses to University-Wide Disruptions
- Academic Honesty
- Accessibility and Statement of Reasonable Accommodations
- Attendance and Roster Certification
- Book Purchasing
- COVID-19 Exposure or Diagnosis
- Recording of Class Sessions
- Religious Holy Days
- Safety Precautions
- Student Support Services
- Student Counseling Services
- Technology Requirements
- Testing and Final Exams
- Use of Blackboard, Gatormail, and Zoom

Campus carry: As of August 1, 2016, the "Campus Carry Law" (SB 11) is in effect on the UHD campus. Any individuals who hold a current and valid License to Carry may carry a concealed handgun on or about their person, where permitted on UHD property. Certain areas of campus have been designated as gun-free areas, and there are notices or signs at those locations. Please refer to the UHD Campus Carry Policy (https://www.uhd.edu/police-department/campus-carry/Pages/default.aspx) for a list of the areas designated as gun-free and to understand your rights and responsibilities under the policy.

COURSE POLICIES:

Attendance is mandatory. It will be checked in every class. The perfect attendance weighs 10% of the final grade for this course. In case of absence the student must offer explanation to the Professor in face-to-face meeting.

Acceptance of late work. Late work must be explained to the Professor in face–to–face meeting.

Safety in the lab:

- Before starting experimental activity, each student is required to get familiar with safety rules as explained in the safety folder available in OMB S812AC.
- General safety rules to be observed: https://www.uhd.edu/academics/sciences/computer-science-engineering-technology/Pages/cset-laboratory-safety.aspx
- Laboratory Safety Manual: https://www.uhd.edu/administration/environmental-health-safety/ls/Pages/LSM-Standard-Operating-Procedures.aspx

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CHANGES TO SYLLABUS.

Since student success is my primary goal, I reserve the right to alter/adjust this syllabus to changing circumstances during the semester. All the changes are always discussed with students in class. Students are encouraged to give me feedback about my performance as instructor.