University of Tennessee at Chattanooga

Department of Chemistry and Physics

Five-Year Review Document

2018 – 2023

PHYSICS PROGRAM

PREFACE/HISTORY

The physics program serves our majors as well as students from all across the university. We offer a B.S. in Physics; B.S. in Physics: Biophysics, and a B.S. in Physics: STEM Education. Averaged over the 5-year period 2018-2022, the program enrolls 26.8 majors and graduates 4.6 students per year. The physics program also contributes to degrees in other sciences, engineering, and professional studies, by offering courses that relate to these other majors. Majors from the College of Engineering and Computer Science, as well as from the Chemistry and Biology programs, are the highest percentage of students registering for physics courses. Because of its emphasis on natural science, students matriculate in physics courses for graduate and professional health programs requiring the Graduate Records Examination (GRE), Medical School Admissions Test (MCAT) and Dental Admissions Test (DAT).

Although our graduation numbers are rather low compared to other programs on campus, we are comparable to physics programs in Tennessee (see Table 6.2) as well as nationally. The American Institute of Physics reports that the median number of physics degrees awarded annually by undergraduate-only institutions across the country is **five**, so UTC ranks just below this number. Furthermore, the literature clearly shows that the number of physics degrees awarded directly scales with the number of FTE faculty, and the previous source also shows that the average number of FTE physics faculty at undergraduate-only institutions is **6.3**. The UTC Physics program has always been below that number, especially before two new faculty were hired in Fall 2022, so it is a testament to the hard work of our faculty to maintain this high output through the last five years.

A feature of our physics program is the historic UTC Clarence T. Jones Observatory, which provides astronomy presentations to the community at large. The latest schedule for the Observatory can be found on our website. The program also offers astronomy and astrophysics courses. Further details of the Observatory are in Section 6.3.

Recommendations and Actions from the Last Review:

The last external review for the physics program was conducted in 2017. There were six recommendations that the external reviewer highlighted. We carefully reviewed these

recommendations and are happy to report progress on them here. In particular, our biophysics lecturer position was upgraded to a tenure-track line in 2022 to better support the biophysics program. The Jones Observatory has also remained a focus of our program with increased outreach and upgrades to the facility.

1. Increase Enrollments in PHYS 2300: It was recommended that we explore the possibility of having engineering students take our first semester calculus-based introductory physics course in place of their ENME 1030 Basic Engineering Science course since the two courses are very similar. The Physics Program was very receptive to this idea, and we had several discussions with our engineering colleagues about this. Unfortunately, Engineering has not been interested in making this change beyond sending their overflow students to PHYS 2300.
2. Physics as a Gateway to Engineering: We have followed this recommendation and encouraged our graduates to pursue advanced degrees in engineering. Since the last program review, we have had students pursue graduate degrees in Nuclear Engineering and Computer Engineering.
3. Continue to Develop the Biophysics Track: We have continued to keep a major focus on our Biophysics concentration. We were fortunate to make a new tenure-track hire in Fall 2022 with an emphasis in Biophysics to replace the Biophysics faculty line we lost in 2016.
4. Increase Support for Society of Physics Students and Sigma Pi Sigma: We have also continued to support our Society of Physics Students. The chapter has had increased activity in the years coming out of the pandemic, and they received national recognition in 2021-2022 as a Distinguished Chapter by the national SPS organization. We also followed the reviewer's recommendation to renew the Sigma Pi Sigma physics honors society. We restarted annual induction ceremonies for new students in 2021.
5. Contact Hours for Laboratory Instruction: The recommendations mentioned here were not pursued, and our teaching loads have not really changed since the last review. We are continuing to try to increase the teaching staff in order to decrease the number of sections each faculty member teaches.
6. Enhance Instructional and Outreach Activities Using the Clarence T. Jones Observatory: We have maintained our active outreach program with the Observatory. Although we have not pursued research activities with the Observatory that were recommended in the last review,

that may change going forward if we are able to hire a professional astronomer to run the Observatory.

Accomplishments and Challenges Since the Last Review:

1. We lost one tenure-track line due to a faculty retirement in Spring 2020. The status of this line remained in limbo for a couple of years along with our ability to maintain our course offerings. However, in Fall 2022 we were able to hire two new tenure-track faculty: one in biophysics and one in quantum information science (see Section 4.1).
2. UTC has invested in a major focus on its quantum initiative along with industry partners. Our program is at the forefront of this new endeavor, especially due to our new faculty hire in this specialty (see Section 6.3).
3. The physics faculty have taken a proactive approach to investigating ways to increase student enrollment in our program. Two faculty participated in the Department Action Leadership Institute funded by the American Physical Society, where they received training in forming a diverse Department Action Team and affecting positive changes within the program.
4. Since the last program review, the physics program has been able to participate in our department's summer undergraduate research program. Each year several physics faculty and students participate in this 10-week long research program.
5. The physics program teaching load continues to rank near the top of the university's student credit hour production (SCH). Even though our major numbers are low, we contribute substantially in teaching load (see Section 4.2).
6. Our Society of Physics Students (SPS) chapter received a grant from SPS National in 2022 to carry out an independent research project. It has also received a "Distinguished Chapter" standing for 2021-22 academic year (see Section 3.3).

1. Learning Outcomes

1.1 Program and student learning outcomes are clearly identified and measurable.

The outcomes assessment process is a campus wide program designed (a) to assess teaching quality and results, and (b) to fulfill the departmental evaluation requirements of the Southern

Association of Colleges and Schools Commission on Colleges (SACSCOC). Our department started to engage in this program in 2004. Our objectives are:

1. Demonstrate Knowledge and Competence: Students demonstrate both knowledge and competence in understanding and applying fundamental laws of physics to specific natural phenomena in five key topic-area fields of physics: (i) classical mechanics, (ii) electricity and magnetism, (iii) thermal physics, (iv) modern physics including relativity and quantum mechanics, and (v) experimental methods.
2. Critical Thinking: Students are able to use critical thinking, hypothesis building, and application of the scientific method to physics concepts, theoretical models and calculations, and laboratory experimentation.
3. Problem Solving Skills: Students demonstrate competence in problem solving skills and relevant mathematical methods; that is, they will be able to conceptualize and achieve analytical or numerical solutions to physics problems within important sub-categories of the five topic-areas referred to in LO(1).
4. Appropriate Laboratory Skills: Students show appropriate laboratory skills drawn from experiencing a variety of important experiments at appropriate levels which illustrate phenomena discussed in the lecture classes. These skills will include a working knowledge of instrumentation and experimental techniques, and methods for quantitative analysis of data and measurement uncertainty.
5. Knowledge of Contemporary Areas of Physics: Students have a knowledge of contemporary areas of physics inquiry, as introduced in upper-level physics and interdisciplinary elective courses, as well as in faculty-mentored undergraduate research, which is available to all majors who seek this experience.
6. Written and Oral Communication Skills: Students demonstrate written and oral communication skills for dissemination of scientific results in reports, articles, or oral presentations, making use of standard citation methods. They will be aware of the importance of ethics to scientific inquiry and professionalism.
7. Ethical Behavior: Students will be able to explain why ethical behavior is essential to scientific inquiry and professionalism.

To achieve these objectives, we have embedded an assessment program into our curriculum as described in the section below. In addition, the UTC Office of Accreditation and Assessment surveys graduating seniors to obtain feedback from our students for future improvement of our program and assess student success in terms of employment or other future plans.

In 2007-2008, the university adopted TaskStream, a web-based solution for performance assessment. UTC has subsequently replaced TaskStream with *Anthology – Planning* by Anthology to capture outcomes and assessment information. The results of these assessments have shown that our teaching is effective (see Section 1.2). For General Education courses, a similar but separate method of outcomes assessment was adopted. We use embedded assessment, collecting and analyzing artifacts of student work by campus-wide committee that assess learning of the General Education – Natural Sciences (with and without lab) student learning outcomes (SLOs).

1.2 The program uses appropriate evidence to evaluate achievement of program and student learning outcomes.

Upon the recommendation of the Office of Accreditation and Assessment, the physics program has adopted a method of outcomes assessment based on rubrics. Rubrics are an evaluative matrix tailored to specific assignments to measure student skill level to be in one of three categories: exceeding expectations, meeting expectations or below expectations. Our goal is to have at least 75% of students exceeding or meeting expectations. See the **Appendix** for our annual assessment reports.

We have performed the following outcome assessments during the review period:

Table 1.2. Physics Program Outcomes Activities from 2018 to 2023.

2022-2023
SLO 5. Knowledge of contemporary areas of physics in PHYS 4300/L
Develop and Assess Effectiveness of Physics Department Action Team
Develop clear purpose and intent of program by updating learning objectives
2021-2022
SLO 6. Written and Oral Communication Skills in ASTR 4010
Develop clear purpose and intent of program
Develop recruitment and retention plan
2020-2021

SLO 3. Problem Solving Skills in PHYS 4250
Develop clear purpose and intent of program
Develop recruitment and retention plan
2019-2020
SLO 4. Appropriate Laboratory Skills in PHYS 3990
2018-2019
SLO 1. Demonstrate knowledge and competence in PHYS 3980

1.3 The program makes use of information from its evaluation of program and student learning outcomes and uses the results for continuous improvement.

The results of the outcome assessment are used to improve our teaching in many ways: 1) The assessment results are used to identify the areas that need reinforcement in teaching, and the instructions are adjusted accordingly; 2) The syllabi may be changed to reflect these needs; 3) If the issues are general enough to be addressed throughout the physics program, departmental meetings are called to discuss these issues and to plan the ways to address the issue.

The results of outcomes assessment are reviewed by the faculty at least annually during a department meeting to identify the areas of potential improvements in the following academic year, and plans are made to address the issues indicated by the rubric results. For example, in 2020-2021, students completed a semester-long project in PHYS 4250 Computer-Based Materials Development in Science. Based on the assessment results from 2017-2018, improvements were made in the course and the rubric was re-applied to determine whether or not student outcomes improved.

1.4 The program directly aligns with the institution's mission.

The purposes of the Physics Program at UTC are to pursue excellence in our teaching, produce relevant science courses for majors across campus, mentor undergraduates in original research, provide STEM outreach to the Chattanooga area, and foster a climate of diversity. These objectives reflect the mission of UTC:

Table 1.4 Mission of UTC and Physics Program

UTC Mission	Physics Program Mission
Engaging students, faculty and staff	Teaching majors and non-majors using active pedagogies

Embracing diversity and inclusion	Encouraging minorities and women participation in department
Inspiring positive change	Graduating students with research skills to be leaders in their field
Enriching and sustaining our community	Bringing STEM activities into the community

2. **Curriculum**

In this section of the self-study, the major focus is on the available choices, sequencing, and scheduling of physics courses for the B.S. degree. In addition, we describe the general education courses offered by our program in physics, astronomy, and general science. We next present the balance between the required and elective courses for the degree, followed by current approaches to teaching, opportunities for student research, and the development of appropriate student skills through their coursework.

Overview of Curriculum

The core courses of the physics curriculum are those traditional offerings which are absolutely necessary in order to pursue graduate work; a descriptive listing of these courses follows (syllabi are compiled in the **Appendix**). In addition, we have created a new course, PHYS 1250 – The First Year Experience in Physics, which introduces entering freshmen to our department. The core courses are:

PHYS 1250:	The First Year Experience in Physics (1 hr)
PHYS 2300/2300L:	Introductory calculus-based mechanics with lab (3+1 hrs)
PHYS 2310/2310L:	Introductory calculus-based electricity and magnetism with lab (3+1 hrs)
PHYS 2320/2320L:	Introductory calculus-based optics and modern physics with lab (3+1 hrs)
PHYS 3410/3410L:	Intermediate mechanics with recitation (4 hrs)
PHYS 3420/3420L:	Intermediate electricity and magnetism with recitation (4 hrs)
PHYS 3980:	Methods of experimental physics I: classical experiments with lab (3 hrs)
PHYS 3990:	Methods of experimental physics II: modern experiments with lab (3 hrs)
PHYS 4110:	Introductory quantum mechanics (3 hrs)

PHYS 4300/4300L: Physics of Living Systems with lab (3+1 hrs, required for Biophysics majors)

All other physics (and all astronomy) courses are Electives. The entire listing and descriptions for all department courses may be accessed at in the UTC Undergraduate Catalog. On the Chemistry and Physics Departmental website, links are available for all three physics degree programs: Physics, B.S; Physics: Biophysics, B.S.; and Physics: STEM Education, B.S. In order to focus the attention of our physics majors on those upper-level elective courses which are expected by graduate schools to be part of their background, the UTC catalog states under "Recommended Courses" for physics and/or astronomy:

Recommended: Physics 3030 (Basic Electronics), 3070 (Optics), 3110 (Introduction to Thermal Physics), 4120 (Nuclear Physics), and 4140r (Advanced Modern Physics) are recommended for students who plan on graduate study in physics/astronomy.

Our program also presently contains seven introductory courses (six with co-requisite laboratories) which are certified as General Education, i.e., each of these lecture/labs can be used to satisfy 3-4 hours of the university's natural science requirement, and therefore they are taken by a diverse body of students coming from all majors across the university. All of the associated lab courses involve computer technologies which introduce the student to data collection and analysis, especially through graphing. These courses are:

(1) General Science 1150 Science and Society (3 hrs)
(2) Astronomy 1020 Introduction to Astronomy: Stars to Galaxies (3 hrs)
Co-requisite lab: Astronomy 1020L Astronomy Laboratory – Stars to Galaxies (1 hr)
(3) Astronomy 1010 Introduction to Astronomy: The Solar System (3 hrs)
Optional lab: Astronomy 1010L Astronomy Laboratory – The Solar System (1 hr)
(4) Physics 1030 General Physics - Mechanics and Heat (3 hrs)
Co-requisite lab: PHYS 1030L General Phys. Laboratory – Mechanics and Heat (1 hr)
(5) Physics 1040 General Physics – Electromagnetism and Optics (3 hrs)
Co-requisite lab: PHYS 1040L General Phys. Laboratory – Electromag. and Optics (1 hr)

(6) Physics 2300 Principles of Physics - Mechanics and Heat (3 hrs)
Co-requisite lab: PHYS 2300L Principles of Physics Lab – Mechanics and Heat (1 hr)

(7) Physics 2310 Principles of Physics – Electricity and Magnetism (3 hrs)
Co-requisite lab: PHYS 2310L Principles of Physics Lab – Electricity and Magnetism (1 hr)

2.1 The curriculum content and organization are reviewed regularly and results are used for curricular improvement.

We regularly evaluate our course offerings in terms of scheduling, content covered, and new course proposals in order to improve our curriculum. These topics are further discussed in the following sections.

Some examples of curricular improvements we have made in the last five years include:

- Establishing PHYS 1250 - The First Year Experience in Physics course to give our entering freshmen physics majors a course that engages them and introduces them to our department. This goal of this new course is to improve our retention of freshman physics majors.
- We have begun to offer PHYS 4250 - Computer-Based Materials Development in Science since the last program review cycle. It is a course centered on computer modeling and simulation using the python programming language and teaches our majors who had not had coding experience a very valuable skill.
- In the present academic year (2023-2024), we have put in a curriculum proposal for a new course entitled PHYS 1350 Introduction to Data Analysis and Python Programming for STEM students which will give them programming experience at the lower-level as well.
- This year we have also put in several curriculum proposals based on new courses and a new degree concentration centered on Quantum Information Science.

Our program currently offers a B.S in Physics in addition to specialized concentrations in Biophysics and STEM Education. Our curriculum is well-balanced and prepares our graduates to

enter graduate school or the work force (often in a related area, e.g., computer programming, meteorology, electronics, nuclear power). About half of our graduates have opted for graduate school: examples include Yale University, Vanderbilt University, University of Tennessee, Notre Dame University, and Louisiana State University in such areas as physics, materials science, data analytics, and biophysics.

2.2 The program has developed a process to ensure courses are offered regularly and that students can make timely progress towards their degree.

Since the last program review, we did a complete evaluation of our courses and the schedule with which we offer them. We developed a 4-year course schedule that shows when the required major courses will be offered, and it ensures that students will be able to complete their degree within 4 years. We keep the schedule updated and post it on our department website at (see **Appendix** for sample schedule). From this schedule it is evident that most upper-level courses are now on a 2-year schedule. This was a necessary step to take in order to prevent low-enrolled yearly courses that were in danger of being cancelled.

In addition to the 4-year course schedule, our majors are provided a *Clearpath* document which gives a sample 4-year class schedule that a physics major would take. Although no student follows the *Clearpath* exactly, it provides a useful "roadmap" to follow as they step through the curriculum.

2.3 The program incorporates appropriate pedagogical and/or technological innovations that enhance student learning into the curriculum.

The physics, astronomy, and general science curriculum offers a very wide and diverse set of courses ranging from the introductory and general education courses available to all students at our university to the 3000- and 4000-level specialized courses that are mostly taken by our majors, although any student that satisfies the pre-requisites is welcome to enroll.

Our university uses the Canvas learning management system for every course, and every classroom has a podium computer with projector. Our instructors post important course material on Canvas, and we also use Canvas to collect and grade assignments. In the classroom, we project useful lecture slides and other media. Our university also has a license for the PollEverywhere classroom response system, and it is used to increase student engagement through clicker-style questions. Most classrooms are equipped with the Kaltura video capture system for recording of lectures.

All of our laboratory courses are held in lab rooms with a computer station for each lab group. Many of our labs involve computer-assisted data collection and analysis using Vernier hardware and software such as LoggerPro and Graphical Analysis. The computers also have the Microsoft Office suite of programs installed to prepare lab reports.

During the pandemic, we were forced to switch all of our courses to an online modality, and because of that, we have been able to continue offering certain courses online, which has proven very convenient for students. We now offer online lecture sections of GNSC 1150 – Science and Society as well as ASTR 1010 – Introduction to Astronomy: The Solar System each semester, and they are consistently enrolled to capacity.

2.4 The curriculum is aligned with and contributes to mastery of program and student learning outcomes identified in 1.1.

We have developed a curriculum map which shows where, within our required major courses, important concepts are introduced, practiced, and then shown competency by our students (see **Appendix**). Generally, key physics topics are introduced in our 1000-2000 level courses, practiced in the 3000-level courses, and then competency is demonstrated at the 4000-level. The upper-level courses especially focus on advanced mathematical methods and laboratory techniques. Our department has an assessment committee that is charged each year with evaluating three student learning outcomes related to our courses each year. See Sections 1.1 - 1.2 for more discussion of the program and student learning outcome assessments we complete each year.

2.5 The curricular content of the program reflects current standards, practices, and issues in the discipline.

Coursework at the 3000- and 4000-level often provides opportunities for faculty to give more in-depth analyses not only on their own research, but also on currently "hot" topics. The exposure of physics majors to methods of inquiry that are commonly used in the field is found throughout the curriculum, but for the most part is concentrated in upper-level laboratory activities and independent research. For example, students are exposed to a variety of apparatus (e.g., amplifiers, delay lines, counters for radiation dosimetry and x-ray scattering) in Physics 3990 - Methods of Experimental Physics II. In Physics 3030 - Basic Electronics, digital oscilloscope techniques are encountered, as well as analog and digital electronics. Demonstration helium-neon lasers are used for holography by students in Physics 3070 - Optics, as well as for other experiments in the advanced laboratory courses.

At the 1000- and 2000-level, students gain some initial familiarity with interferometers, diffraction gratings, lasers, lenses, oscilloscopes, digital multimeters, radiation counters, and multichannel analyzers, all of which are commonly used to obtain data about the physical environment.

We collect student lab fees for each lab course we offer, and we use those fees to constantly improve and upgrade both our more advanced and introductory physics laboratory equipment.

2.6 The curriculum fosters analytical and critical thinking and problem-solving.

All of the courses in the physics program, including astronomy and general science, assist student development of analytical, critical thinking, and problem-solving skills. We particularly focus on the growth of these skills in our majors by providing original research experiences. Our curriculum makes provisions for faculty-supervised student research. For example, in Fall 2022 our PHYS 4999r – Group Studies course was used for our Society of Physics Students to work on constructing and implementing a Kibble Watt Balance made out of Lego® blocks. We also offer PHYS 1999r - Special Projects courses for 1000- or 2000-level research projects, and the

PHYS 4998r - Individual Studies and PHYS 4997r - Research for more advanced projects. All courses specifically set for student research are of variable credit (1-9 hours). Most of our faculty involve at least one student in the Research course each semester. In addition, the physics curriculum provides for a multi-semester PHYS 4995r Departmental Thesis (1-3 hrs) research project.

Majors are encouraged to participate in collaborative research with faculty, to attend scientific meetings at both the state and regional level, and to present papers or talks at scientific meetings. Every Fall semester we send a group of students and faculty to the Annual Meeting of the Southeastern Section of the American Physical Society (SESAPS). In November 2023, three physics majors and two faculty attended the meeting and presented poster and talks on their research at the SESAPS meeting at Eastern Kentucky University. Their attendance was funded by the department and University. We also encourage students that have completed exceptional research work to present at national meetings. This was most recently done at the 2020 APS March Meeting and the 2021 and 2022 APS Division of Nuclear Physics Meetings.

Beginning in Summer 2017, not long after the formation of our new Department of Chemistry and Physics, the physics faculty and students have been able to participate in our department's summer undergraduate research program (URP). This program is a fully self-funded program to allow for 10 weeks of research where students work closely with a faculty member in the summer.

In addition, we encourage our students to pursue external research programs: the NSF Research Experience for Undergraduates program (REU) and the Summer Undergraduate Laboratory Internship program (SULI) at national labs. We have recently had students participate in REUs at the University of Alabama, international research in Cadiz (Spain), as well as SULI internships at Oak Ridge National Laboratory.

Another benefit of the formation of the Department of Chemistry and Physics is the opportunity for our program to participate in the department's seminar series. The chemistry program has long held a seminar series during the academic year where they bring in external speakers, and

now the schedule includes 1-2 physics-centered seminars each year. Our own physics faculty have had the opportunity to present at the seminars on their research.

2.7 The design of degree program specific courses provides students with a solid foundation.

The curriculum provides students with a background covering all major areas of physics: mechanics, thermodynamics, electricity, magnetism, optics, modern physics, and quantum mechanics. The associated laboratory courses give students practice in designing experiments, acquiring data, and analyzing results. The upper-level elective courses also go into more detail on specialized topics.

As mentioned in section 2.1, we are working to incorporate more computer modeling/simulation as well as Quantum Information Science topics into our curriculum.

Students also gain the necessary mathematical skills through the required math courses:
Mathematics 1950 Calculus with Analytic Geometry I (4 hrs)
Mathematics 1960 Calculus with Analytic Geometry II (4)
Mathematics 2200 Elementary Linear Algebra (3)
Mathematics 2450 Introduction to Differential and Difference Equations (3)
Mathematics 2560 Calculus with Analytic Geometry III (4)

2.8 The curriculum reflects a progressive challenge to students and that depth and rigor effectively prepares students for careers or advanced study.

As stated in section 2.4, we follow our course curriculum map which shows where, within our required major courses, important concepts are introduced, practiced, and demonstrated competency by our students. The upper-level courses especially focus on advanced mathematical methods and laboratory techniques that provide substantial rigor. We also provide research opportunities for our students. And they have opportunities to get involved with the outreach program at the UTC Jones Observatory. Our graduates complete a rigorous curriculum and are

well-prepared to pursue graduate studies, professional schools, or to enter industry (see Section 2.1).

2.9 The curriculum encourages the development of and the presentation of results and ideas effectively and clearly in both written and oral discourse.

All of our laboratory courses require the production of high-quality lab reports which act as stand-alone documents outlining the student's investigative work. Many faculty also implement student presentations on a topic of their choosing in our upper-level courses. This has been done most recently in PHYS 4110 - Quantum Mechanics, ASTR 4010 - Solar System Astrophysics, PHYS 4250 - Computer Based Materials Development in Science, and PHYS 3110 - Introduction to Thermal Physics.

Students are also encouraged to participate in research with our faculty, and those endeavors often yield oral and poster presentations at our department's annual research night, the University's Spring Research and Arts Conference, in addition to regional and national physics meetings.

2.10 The curriculum exposes students to discipline-specific research strategies from the program area.

As mentioned previously, we offer a specific course, PHYS 4997r – Research, where students can work one-on-one with a faculty member doing actual research within the faculty member's specialty. Since our five faculty each have unique research specialties in biophysics, material science, quantum optics, cosmology, and nuclear physics, students can gain access to research methods in a variety of disciplines. We also encourage every major to apply for our department's summer undergraduate research program, in addition to seeking out external research opportunities in the summer.

The curriculum allows students to become proficient in using a variety of experimental techniques such as spectroscopy, multi-channel analyzers, etc., as well as data collection, analysis, and simulation techniques.

3. Student Experience

3.1 The program provides students with opportunities to regularly evaluate the curriculum and faculty relative to the quality of their teaching effectiveness.

The University collects course learning evaluations from students for all classes every semester. Each student has the opportunity to submit an evaluation of the instructor's performance and course design in a standard ratings form submitted online. In addition, students can provide specific, written feedback in the evaluation. Results of the student evaluations and any written feedback are available to the instructors at the end of every semester, once grades have been submitted. Instructors are able to use the feedback to make any changes to their instruction if necessary.

These evaluations also factor into a faculty member's annual performance evaluation during the faculty Evaluation and Development by Objectives (EDO) process with the department head. The department head and dean of the College of Arts and Sciences have access to all faculty rating information.

The physics majors in our program are also able to provide feedback about the curriculum through the department's Student Advisory Council, which meets at least once a semester. Additionally, given the size of our program and the informal, friendly relationships with the physics students, students are in a unique position to request that certain upper-level physics and astronomy electives be offered in an upcoming semester if there is enough interest and it fits into the course schedule. We make every effort to accommodate student requests of this kind since it shows that students are taking an active role in their education.

3.2 The program ensures students are exposed to professional and career opportunities appropriate to the field.

Students are made aware of and encouraged to participate in all applicable conferences, research programs, and job opportunities. For example, students are encouraged to apply for summer research programs such as the Department of Chemistry and Physics Undergraduate Research Program (URP), Undergraduate Research and Creative Endeavor (URaCE) and the Scientific Undergraduate Laboratory Internships (SULI) programs. Students are also encouraged to attend regional and national meetings such as the Southeastern section meeting of the American Physical Society (SESAPS), National American Physical Society, Biophysics society meeting, Conference on Undergraduate Women in Physics hosted by the American Physical Society, or the American Association of Physics Teachers (AAPT) annual meeting. Information about these programs is posted in the Physics Students group in UTC Learn (Canvas) as well as emailed to the students. Information about these programs is also posted on the bulletin board just outside the physics faculty offices and is kept updated.

Additionally, for students who intend to work in the industrial sector, the department has established an internship program. We assist students in making connections with local companies associated with their field. They can earn credit towards their degree for these experiences in PHYS 3900r – Internship course.

The departmental seminar series brings at least five professions to campus each semester and students are encouraged to attend their talks and meet with the speakers to learn about their profession.

3.3 The program provides students with the opportunity to apply what they have learned to situations outside the classroom.

Students apply their knowledge outside of the classroom in a number of different ways. In addition to the internship and summer research summer research programs mentioned in the previous section, students have many options for conducting research at UTC. The most often utilized method is by performing research with a faculty member by enrolling in PHYS 4997r - Research during the academic year. Students can also seek funding for summer research at UTC by applying for the Department of Chemistry and Physics URP. Another option for students is to

develop a research project and gain funding by applying for UTC's URaCE program. Students can also complete a Departmental Honors (DHON) Thesis (PHYS 4995r), a two-semester sequence of original research which concludes in the defense of a written thesis before a faculty committee. Below are the DHON theses completed in physics during the review period: all are available in the UTC Scholar database.

2019 Courtney Baier (mentor Luis Sanchez Diaz), "Active colloid behavior exhibiting soft-sphere characteristics for non-Newtonian solvent."

2020 Benjamin Smith (mentor Luis Sanchez Diaz), "Molecular dynamics simulations of apolipoprotein A1 in ionic liquids."

2021 Hannah Holmberg (mentor Luis Sanchez Diaz), "Molecular Dynamic Simulation of the Complex Folding Patterns of Apolipoprotein A1 in Various Concentrations of Potassium Chloride."

2021 Mackenzie Wall (mentor Luis Sanchez Diaz), "Understanding Shear Thinning using Brownian Dynamic Simulation."

2021 Alexandra Paladian (mentor Luis Sanchez Diaz), "The effect of the apolipoprotein A1 (APOA1): the stability and folding in potassium chloride environment."

In the last year, students from our local chapter of the SPS have obtained a grant from the national SPS organization. The grant funding allowed them to build a LEGO-based model of the Watt (Kibble) Balance. After a research project is complete, students are encouraged to present their research at an appropriate regional or national conference, in addition to presenting at UTC Spring Research and Arts Conference (formerly ReSEARCH Dialogues). UTC also sponsors students to present at the Posters at the Capitol, where they present their research to legislators in Nashville, and the National Conference on Undergraduate Research.

In addition to engaging in research, students pursuing physics can also assume the role of a Teaching Assistant (TA) for the physics and astronomy laboratory sessions. Students who successfully finish their first year of physics courses have the opportunity to support the lab instructor by assisting in the setup of experiments and providing guidance on technical inquiries posed by freshman students. Also, students can volunteer and work at UTC's Clarence T. Jones Observatory as part of our outreach program. The students assist with a weekly observatory show during the academic year that is free and open to the public. Students also assist with the deep-sky viewing program that occurs once a semester in accordance with the introductory astronomy courses.

3.4 The program seeks to include diverse perspectives and experiences through curricular and extracurricular activities.

As mentioned above, students are encouraged to participate in summer research programs at universities and laboratories around the country. The female physics majors are also encouraged every year to attend the annual Conference on Undergraduate Women in Physics hosted by the American Physical Society. The physics students run their own chapter of the SPS and participate in many outreach events throughout the year (Table 3.4).

Table 3.4. Physics Program Outreach Events

Examples of Outreach Events	
2018, 2019, 2021, 2022, 2023	UTC Jones Observatory Sunday Night Program (500 visitors per semester)
May 2023	St Andrew's Sewanee Advanced Chemistry and Physics class tours
December 2022	Host Girls Preparatory School 7th grade astronomy projects
April 2022 and 2023	SPS volunteer at Creative Discovery Museum
March 2022 and 2023	Chattanooga School for Arts and Sciences Career Day
March 2020	Math Kangaroo
January 2020	Hosted Red Bank Middle School
December 2019	Hosted Orchard Knob Middle School
March 2019	Math Kangaroo
November 2018	Soddy Daisy High School Science Extravaganza

March 2018	Red Bank Middle School Book Club A Wrinkle in Time/Black Holes Discussion
April 2018	Visited Girls Preparatory School

The physics faculty come from diverse backgrounds, and each has his/her own unique field of research expertise. This allows our students to be exposed to many different scientific perspectives. Accordingly, students are offered a wide range of physics courses, such as Optics, Nuclear Physics, Relativity, Computational Physics, Biophysics, Quantum Physics and Astrophysics.

To promote community-building in the department, we hold a number of student-centered activities throughout the academic year, including an open house during each Welcome Week, a group advising session, meet an alumni lunch, and an annual awards banquet in the spring.

The physics program also brings in outside speakers to present talks that are open to the entire university in order to provide diverse perspectives. During the department seminars and summer undergraduate research the program hosted speakers from Oak Ridge National Laboratory and Vanderbilt University, for example.

3.5 Students have access to appropriate academic support services.

The university has a number of services dedicated to ensuring the academic success of students. The Counseling Center at UTC offers individual and group counseling that covers a wide range of issues such as dealing with the adjustment to college life, stress, anxiety, time management, substance abuse, and study skills. The Center for Academic Support and Advisement (CASA) provides free tutoring in a number of popular introductory classes in physics, chemistry, mathematics, and other departments. CASA also provides supplemental instruction (SI) sessions for these courses that are run by upper-level students (often physics majors) who answer questions and work with students who are seeking extra help in their large lecture classes. In addition, CASA provides a number of resources on note-taking, reading tips, exam preparation, and other skills necessary for academic success.

Our department works closely with UTC's Disability Resource Center to provide all students with disabilities the necessary accommodations to be successful in class. These services include note takers in class, testing with extra time in a distraction-free environment, and audio or video transcription of class materials.

The physics faculty also work individually with physics majors and other students in order to ensure their success. The faculty host regular office hours and post their teaching schedules outside their office doors in order to show their availability to students. Students are always encouraged to make use of the scheduled office hours for help in class and also schedule an appointment outside of office hours if necessary. Each physics major is assigned an academic advisor from the physics faculty, and the student and advisor meet at least once a semester to make sure they are successful in their courses and progressing towards graduation.

For students interested in applying to professional schools in the health sciences, the College Hub has a dedicated staff member and the department designates a faculty member as the pre-med advisor in physics.

4. Faculty

4.1 All faculty, full-time and part-time, meet the high standards set by the program and expected SACSCOC guidelines for credentials.

The Physics program merged with the Department of Chemistry in the fall of 2015, forming the Department of Chemistry and Physics. Recent department heads have been Dr. Manuel Santiago (Fall 2016 – Spring 2019), Dr. John Lee (Fall 2019- Spring 2020), and Dr. Keenan Dungey (Fall 2020 – now), all chemists due to accreditation requirements of the American Chemical Society.

The Physics program appoints an associate department head and Dr. Josh Hamblen has held this role since the fall of 2018.

The number of tenured (T)/tenure-track (TT) faculty fluctuated during this 5-year period. In the fall of 2018, we had four tenured faculty members and one lecturer. However, one person retired in the spring of 2020, so for two years we were down to three tenured faculty members and one lecturer. We were very fortunate that in the Fall of 2022 we were able to hire two TT assistant professors, but we lost the lecturer's line (our lecturer was hired as one of the TT assistant professors). Currently the program holds five T/TT lines and no lecturers, but we are approved for a search for a lecturer in the 2023-24 academic year.

The number of full-time faculty is broken down according to professional rank in table 4.1.

Table 4.1 Number of full-time faculty according to rank Fall 2018 to Fall 2023

Professional Rank	**Fall 2018**	**Fall 2019**	**Fall 2020**	**Fall 2021**	**Fall 2022**	**Fall 2023**
Professor	3	3	2	2	3	3
Associate Professor	1	1	1	1	0	0
Assistant Professor	0	0	0	0	2	2
Lecturer	1	1	1	1	0	0

The Program strongly depends on the adjunct instructors to carry the teaching load. Every semester we employ from two to five adjunct faculty members. Currently, the program has four adjunct instructors. The following roster lists current members of the Program according to their individual rank or position and their expertise.

Fall 2023 Program Roster

Full Time Faculty:

1) Dr. **Tatiana Allen**, UC Foundation Professor of Physics,
Ph.D.: Physics and Mathematics, St. Petersburg State Technical University, Russia
Area of Expertise: Solid state physics and material science

2) Dr. **Joshua Hamblen**, Professor of Physics, Associate Head for the Physics Program.
Ph.D.: Physics, University of Rochester

Area of Expertise: Experimental nuclear physics

3) Dr. **Tian Li**, Assistant Professor of Physics
Ph. D. Joint Quantum Institute, National Institute of Standards and Technology (NIST) and the University of Maryland, College Park, MD
Area of expertise: Quantum optics and sensing

4) Dr**. Luis Sanchez-Diaz**, Assistant Professor of Physics
Ph. D. Autonomous University of San Luis Potosí, Mexico
Area of expertise: Biophysics

5) Dr. **Ling-Jun Wang**, Professor of Physics
Ph.D.: Physics, University of Delaware
Area of Expertise: Cosmology

Lecturer (one-year appointment): none
1) Unfilled position – Search has started for a Fall 2024 hire

Adjunct Faculty: (as of Spring 2023)
1) Mr. **Steven Kline**
M.S.: Education
Area of Expertise: Astronomy
Joined the Program in Fall 2019.

2) Mr. **Jeremy Stewart**
M.S.: Applied Mathematics
Area of Expertise: Classical Mechanics
Joined the Program in Fall 2020.

3) Mr. **Jack Pitkin**,
B.S.: Chemistry, University of Tennessee at Chattanooga

Area of Expertise: Education
Started to teach General Science labs in the spring of 2016.
Full-time faculty members who taught the corresponding lectures supervised Mr. Pitkin's laboratory sessions.

4) Dr. **David Welch**
Ph.D.: Biophysics, University of Boston
Area of Expertise: Experimental biophysics
Joined the Program in spring 2014.

Academic Support Coordinator:

Mr. **Jack Pitkin**, B.S.: Chemistry, University of Tennessee, Chattanooga
Faculty Associate/Senior Teaching Laboratory Specialist.
In addition to setting up and taking down equipment for laboratory sessions, serves as the university-wide radiation safety officer and director of the Jones Observatory.

Administration:

Dr. **Manuel Santiago**, Benjamin H. Gross Professor of Chemistry, Head of Department of Chemistry and Physics (Fall 2016-Spring 2019)
Ph.D.: Chemistry, South Dakota State University
Area of expertise: Biological Chemistry

Dr. **John Lee**, Interim Head of Department of Chemistry and Physics (Fall 2019-Spring 2020)
Ph.D.: Chemistry, North Carilina State University
Area of expertise: Inorganic Chemistry

Dr. **Keenan Dungey**, Head of Department of Chemistry and Physics (Fall 2020-now)
Ph.D.: Chemistry, The University of Michigan, Ann Arbor
Area of expertise: Chemistry

Administrative Support:

Mrs**. Michelle Blackwell**, BS: Business, University of Tennessee at Chattanooga
Full-time administrative support personnel for the Department of Chemistry and Physics (2019-present)

4.2 The faculty are adequate in number to meet the needs of the program with appropriate teaching loads.

The full-time teaching load (FTE) for tenure-system faculty in the department is considered four courses per semester for 9 credit hours or 12 contact hours, not counting mentoring research students or directing honors theses. A typical semester teaching load for full-time tenure-system faculty member in physics consists of one three (3) credit lecture class (up to 35 students); one large three (3) credit lecture (50-80 students), and two labs or recitations (up to 20 students each) worth 1 or 0 credits each (two contact hours each). All tenure-track faculty members are involved in teaching large introductory/general education classes as well as upper-level classes. Lecturers (non-tenure-track faculty, NTT) teach five courses for 12 credit hours or 15 contact hours per semester, but are not expected to conduct research. Introductory labs are taught in parallel in two (2) adjacent rooms, up to 20 students per room, which allows us to maximize available resources.

Our lower-level general education classes (algebra-based physics, astronomy, general science) are in very high demand resulting in large (70-80 students) class sizes. Frequently, we have to turn down students' requests to join closed classes because we do not have enough instructional staff to accommodate them. Our upper-level classes are growing and reaching double digits in student enrollment numbers due to an increase in the number of physics majors and optimizing the schedule.

Faculty teaching productivity, measured in student credit hours (SCH), is summarized in table 4.2.

Table 4.2: Student Credit Hour Production per Full Time Equivalent Faculty

	Total SCH*)	T/TT + NTT	Average
2018 Fall	1549	5	309.8
2019 Spring	1713	5	342.6
2019 Fall	1113	4	278.25
2020 Spring	1177	4	294.25
2020 Fall	1505	4	376.25
2021 Spring	1157	4	289.25
2021 Fall	831	3	277
2022 Spring	1214	4	303.5
2022 Fall	1268	5	253.6
2023 Spring	1428	5	285.6

*) Total SCH includes only hours produced by T/TT faculty and lecturers, does not include hours produced by adjuncts.

These numbers are calculated from the schedule by averaging full-time (FT) faculty loads (not including adjuncts) for all physics, astronomy and general science courses.

Our productivity per FTE faculty is close to 300 SCH, on average. The "National Norm," as determined by the Delaware Study of 2014 (latest information that we have), is 187 SCH for physics. In 2022 we hired two new assistant professors but lost a lecturer's line. Even though with new hires our teaching load is decreasing, we are still very much above the national benchmark. We are still the 5th highest department at UTC in SCH production per T/TT Faculty and **first** among programs that teach laboratory courses. We desperately need adjunct help, but it is very difficult to find qualified instructors to teach physics/astronomy/general science courses at UTC. Chattanooga is becoming a high-tech area, but there are still not many people with advanced degrees in physics or related disciplines, and the adjunct pay precludes drawing qualified workforce from other areas. The lack of qualified adjuncts puts even more teaching demand on the full-time faculty.

Because of such heavy teaching loads, only one member of the program received one semester sabbatical leave in the period between 2018 and 2023 and only two faculty received course release time: one to attend New Faculty Teaching Institute and the other for grant writing. In the spring of 2022, the Department established a Grote Research Fellowship, which is a one course time release to one faculty member (either from the Chemistry or Physics program) if the faculty

member is a PI or co-PI on a major external grant. This fellowship is awarded to Dr. Li for the fall of 2024.

4.3 The faculty strives to cultivate diversity with respect to gender, ethnicity, and academic background, as appropriate to the demographics of the discipline.

The Program features a diverse and talented group of international faculty members from different countries: United States, China, Russia, and Mexico. 20% of the full-time faculty are women.

The physics faculty members have interests in many areas of the physical sciences, including solid state physics, material science, cosmology, high-energy/nuclear physics, quantum optics and sensing, and biophysics.

The physics faculty received their doctorates from a wide range of prestigious universities: University of Rochester; University of Delaware; University of Maryland at College Park, St. Petersburg State Technical University, Russia; Autonomous University of San Luis Potosí, Mexico.

The department formed a Diversity, Equity, Inclusivity, and Respect Committee, published a diversity statement to our website, and developed a diversity action plan.

4.4 The program uses an appropriate process to incorporate the faculty evaluation system to improve teaching, scholarly and creative activities, and service.

The faculty are required to complete an annual Evaluation and Development by Objectives (EDO) report. This professional development report consists of two components:

1. Development by objectives
2. Annual evaluation

To complete the development by objectives portion of the EDO report, the faculty must clearly identify their objectives for the upcoming year within each of the following three standard evaluation categories:

1. Instructional and advisement activities
2. Research, scholarly, and creative activities
3. Professional service activities

By completing the development by objectives portion of the EDO report, the department ensures that each faculty member has a professional development plan in place to enhance his or her role as a member of the department and the university. At the end of the academic year, faculty submit a report of their EDO activities. Recently the EDO process has become entirely digital. All the faculty records and documents are stored in *Digital Measures*, the platform used by UTC that allows faculty to record and track teaching, research, clinical, and service activities. The department head reviews the material in Digital Measures and meets with faculty at least once a semester to discuss their goals and ways to improve their performance. The dean reviews the reports from the department head annually and rates the faculty performance as Exceed Expectations for rank, Meets Expectations for rank, Needs Improvement for rank, or Unsatisfactory for rank.

4.5 The faculty engages in regular professional development that enhances their teaching, scholarship and practice.

Productivity: The department prides itself on a tradition of active and productive research. In spite of the high teaching load and SCH/FTE ratio, the faculty remain active in research as demonstrated by publications in national and international refereed journals, and presentations at national and international conferences. The number of papers that have appeared in print and the number of presentations by faculty at national and international conferences for the academic years 2018 to 2023 are given in Table 4.5.

Table 4.5 Physics Faculty Scholarly Publications and Presentations 2018 – 2023.

Calendar Year	Publications	Presentations
2018	5	7

2019	4	7
2020	3	3
2021	1	5
2022	5	3
2023	0	6

Grants: The department has been successful in obtaining grants from various internal and external sources to support its research efforts over the past five years. These **internal grants** take the form of Faculty Development Grants, Faculty Research Grants, UTC ThinkAchieve Grants, Ruth S. Holmberg Grants for Faculty Excellence, The Center of Excellence in Applied Computational Science and Engineering (CEACSE) grants, and the UTC Research Institute support. The **external grants** come from the Department of Energy/ORNL visiting faculty program, ORNL User grants, NSF grants, and the American Physical Society. These funds are used to support research activities, conference presentations and participation in faculty development workshops.

Continuing Education/ Professional Development: In some cases, conferences offer professional development/ short courses/ tutorials that are included in the conference registration fee. However, it is very difficult, if not impossible, to obtain University funds for attendance of continuing education courses without presenting a paper at a conference. We have been successful in receiving funds from American Physical Society, and Chattanooga Quantum Initiative to engage in professional development.

Awards: Faculty received several prestigious awards, such as the Outstanding Teaching Award from the University of Tennessee Alumni Association, UC Foundation Professorship, and Honorary member of the Golden Key International Honor Society. Physics faculty are frequently honored by "Exceed Expectations" rating on their annual performance reviews (EDO reports).

Collaborations: Faculty research engagements include collaborations with other professionals at different institutions and with UTC students. Faculty use facilities and collaborate with researchers at the Oak Ridge National Laboratory (ORNL), Brookhaven National Laboratory, Chattanooga Quantum Initiative, UTC Research Institute, UT-Knoxville, Tennessee Valley

Authority (TVA), University of Toronto, Covenant College, and A. F. Ioffe Physical-Technical Institute, Russia.

Professional Services: Faculty serve as reviewers to journals such as *Physics Essays*, and *Journal of Biophysical Structure and Dynamics.* They are members of professional organizations such as American Physical Society (including SESAPS and DNP), American Society of Physics Teachers, The Mendeleev Society (Russia). Faculty participate in national and international meetings and sometimes serve as chairpersons at professional meetings. They also advise students at the SPS and UTC's chapter of Sigma Pi Sigma. In 2021-22 our SPS Chapter received a Distinguished Chapter standing from the SPS National. One faculty participated in the APS Career Mentoring Fellows Network for the year 2022-2023 and was also elected Treasurer of SESAPS for a 5-year term beginning on January 1, 2023. Another faculty member has served 2 years on the User Executive Committee at the Center for Nanophase Materials Sciences at ORNL, as well as regularly volunteers for the yearly Conferences for Undergraduate Women in Physics, organized by the APS.

All faculty members regularly serve on UTC-wide committees (as members or chairpersons) as well as members of Faculty Senate. Faculty are also involved in different departmental committees. In 2020 the Physics and Chemistry Department Executive Committee was established, and 2 physics faculty serve in that body. All tenured faculty serve on the Promotion and Tenure Committee.

Faculty serve the wider community by answering questions from the community and occasionally appearing on television to answer the questions of journalists. One of the faculty sponsors a center at UTC for the Math Kangaroo, the International Mathematics Olympiad for grade school students. There are only four centers in Tennessee, and only one in Chattanooga.

Faculty, in collaboration with students, present physics demonstrations at area high schools and community colleges.

Perhaps the department's greatest contribution to our community comes from the Clarence T. Jones Observatory and its Planetarium Annex. The number of area school groups, community organizations and families visiting the observatory has increased. Full capacity service is about 40 attendees per open night. On some Sunday evenings, 90 people have come to use the services of the planetarium and the observatory. On high attendance nights, half of those in attendance enjoy lectures on astronomy as the other half experiences the planetarium; then the groups are swapped so that everyone receives the full benefit of the services. Per semester, 500 people attend the Sunday evening service at UTC's observatory and planetarium. Such outreach will help the department increase its visibility in future years.

4.6 The faculty is actively engaged in planning, evaluation and improvement processes that measure and advance student success.

In the spring of 2021, our department received a grant from UTC CAS to work on implementation of high -impact practices in the physics program. This grant allowed us to apply and be selected for participation in the Department Action Leadership Institute (DALI) which ran from the fall of 2021 for one year. As a result of this work, we formed a Department Action Team (DAT) whose primary task was to increase recruitment and retention in the physics program as well as continue to implement high-impact practices as suggested by the American Physical Society.

The faculty are actively involved in advancing student success beyond the classroom in the following ways:

- All decisions that deal with recruitment, course planning and evaluation, general education courses certification and recertification, outcome assessment, advisement, and other aspects related to student success involve input from all full-time permanent employees in the program. The decisions are made either by consensus or by vote, either at the department meetings or by e-mail.
- Faculty members are actively involved in recruiting new majors. This is done through introductory courses, college fairs, open houses, outreach programs, correspondence with Tennessee high schools and community colleges (see Table 3.4 for recent activities). We are also

involved in designing publicity materials, such as postcards and YouTube videos.

- All tenure-track faculty are involved in student advising. The majors are divided between faculty members evenly, according to the first letter of their last name.
- Faculty members are working with students outside the classroom to ensure their future success. This is done through research, Society of Physics Students, field trips, and informal gatherings.
- Faculty members are involved in discussion and decisions concerning the program scholarships and awards.
- To celebrate diversity and to help under-represented groups to excel in the profession, we encourage our students to participate in the Conference for Undergraduate Women in Physics, organized by the APS. On average, 3 students participate every year. A faculty mentor chaperons them to the conference, volunteers at the conference, and the department helps arrange the transportation.
- Faculty members are involved in writing reference letters to support students' applications for summer research, internships, graduate schools, and post-graduate programs.
- All students have a direct line of communication with faculty members; most questions and issues are resolved quickly, usually by e-mail.

5. Learning Resources

5.1 The program regularly evaluates its equipment and facilities, encouraging necessary improvements within the context of overall institutional resources.

Over the course of the semester, periodic reviews of equipment needs are conducted by the departmental Equipment and Software committee. This is to ensure equipment goals are in alignment with the pedagogical goals of the laboratory experimentation curriculum. One of our goals has been to obtain enough equipment so that two (2) sections of 1000-level labs may be conducted simultaneously. This has had the effect of increasing the efficiency of our student physics lab program.

The most current instrumentation is also sought when older instrumentation no longer functions or has been technologically surpassed with new versions. Instructional equipment is obtained

through operating budgets, student laboratory fees, and internal and external grants, upon the recommendation of the Department Equipment and Software Committee. Major equipment is listed on our website.

In the past five years, the following major equipment acquisitions have been made:

- Tektronic Digital Oscilloscope (a full classroom set of 20 for 40 students)
- Conservation of Momentum and Kinetic Energy Demonstration Track (a half classroom set of 10 for 20 students)
- Upgraded Optics Kit (emphasizing the wave nature of light)
- Upgraded hard drives for all lab computers (postponed the need to delete obsolete software licenses).

As part of the start-up packages for recent hires, the following major research equipment acquisitions have been made:

1. Dr. Luis Sanchez-Diaz

   • PTI (Horiba) Quantamaster Fluorometer/Spectrophotometer
   • Anton Paar Rheometer MCR 102
   • VWR inverted microscope
   • Amscope Compound microscope
   • Micro 12 Centrifuge
   • Benchmark Centrifuge
   • Thermo Fisher incubator
   • Yamato Autoclave

2. Dr. Tian Li

   • Laser (Toptica DLC TA Pro 795)
   • Lock-in amplifier (Stanford Research System SR865A 4MHz DSP)
   • Photo-multiplier tubes and trans-impedance amplifier (Thorlabs PMTSS and TIA60)
   • 1.5 GHz acoustic-optic modulator (Brimrose TEF-1500-100-795)
   • 1.5 GHz RF synthesizer (HP Refurbished 8642B)
   • Photo-detectors with customized photo-diodes (Thorlabs PDB450A-AC and Hamamatsu S3883)
   • Customized ^{85}Rb cells (Precision Glassblowing)
   • Temperature controller (Wavelength Electronics LFI-3751)
   • Oscilloscopes (Rigol DS4024), RF Spectrum Analyzers (Rigol DSA815 and DSA832E), Function Generators (Rigol DG1032Z), and DC Power Supplies (Rigol DP832)

• Quantum network interface console: mounted on a 1 × 42RU rack and consists of a timing and control module along with other devices to support a user's optical and electrical interconnects. It provides physical connections to the quantum network.
• Quantum Opus single-photon detectors: 8-channel superconducting nanowire detectors with high efficiency, low dark counts, low jitter, and fast counting rates.
• PicoQuant HydraHarp: timing electronics enabling 4 ps resolution of detection events and multi-channel (up to 8) correlation measurements.
• Qubitekk QES: entangled photon pair source with integrated laser manufactured by Qubitekk. It is capable of generating type-II down-converted photon pairs around 1570 nm with greater than 10,000 photon pairs/mW/s source brightness.
• Quantum optical kit: an all-in-one kit to perform five quantum optical experiments. The kit includes an entangled photon pair source with integrated laser, two high quality low noise single photon counting modules, an electronic coincidence counter, and other necessary optical hardware.

5.2 The program has access to learning and information resources that are appropriate to support teaching and learning.

The UTC Library has a Physics Research Guide on their website that identifies appropriate databases, indicated below: and includes items indicated below:

Science (Gale OneFile)
Partial Fulltext: Coverage includes a variety of scientific subjects including geology, physics, math, nanotechnology, and engineering. Formerly known as General Science Collection.

ArXiv
Fulltext: Over one million pre-prints in mathematics, computer science, physics, and related disciplines.

Astrophysics Data System Abstract Service
Index: Astronomy, astrophysics, physics, and geophysics literature.

SciTech Connect
Index: Science, technology, and engineering research information from the U.S. Department of Energy.

Web of Science
Index: Includes Science, Social Science, and Arts and Humanities Citation Indexes from 1988-present

Nature Publishing Group Journals
Partial Fulltext: Over 60 science and medical journals including Nature (1869-current) and Scientific American (1845-current).

MathSciNet
In-depth access to the scholarly literature of mathematics. Produced by the American Mathematical Society.

OSTI.GOV
Seventy plus years of research results from the Department of Energy. Includes articles, technical reports, data sets, patents, and more.

General E-Book Collections:

Springer/Palgrave ebooks
Ebooks: 70,000+ ebooks from 2005-2016 covering sciences, social sciences, and the humanities.

Google Books (some full text - see "About")
Ebooks: Free access to public domain books.

Internet Archive (free e-books)
Ebooks: Free e-books and other texts.

Project Gutenberg (free e-books)
Ebooks: Over 45,000 free e-books

Feedbooks (free e-books)
Ebooks: Freely available e-books in public domain

Directory of Open Access Books
Fulltext: Free online peer-reviewed e-books.

The Physics Resources links below can also be found on the Library's website:

- Resources in Physics

  A list of subject specific resources compiled by the Physics-Astronomy-Mathematics Division of the Special Libraries Association.

- American Physical Society

  "The American Physical Society was founded on May 20, 1899, when 36 physicists gathered at Columbia University for that purpose. They proclaimed the mission of the new Society to be "to advance and diffuse the knowledge of physics", and in one way or another the APS has been at that task ever since."

- American Institute of Physics

"Dedicated to the advancement of physics, AIP serves a federation of physical science societies, and provides leadership through its own programs and publications."

- Institute of Physics

  "Physics is central to our society. The Institute of Physics aims to advance physics for the benefit of all."

- Physics.org -- Your Guide to Physics on the Web

Looking for a great physics site? The Institute of Physics has tracked down the very best and checked them for accuracy.

As of June 30, 2023, the UTC Library makes available 124,100 journal titles, including open access titles, through subscriptions to full-text resources, databases, journal packages, and individual journals. In support of the Physics program within the College of Arts and Sciences (CAS), the UTC Library makes available 2,251 print and electronic journals as well as 1,537 electronic proceedings. Physics students and faculty have access to several large, multidisciplinary full-text journal packages and databases to support their scholarship. In the last year for CAS, the Library spent $271,109 for ongoing serial and subscription resource purchases, out of a total spend of $1,369,363 on all ongoing serial and database subscriptions. The UTC community used these resources 418,768 times in the past year.

As of June 30, 2023, the Library's collection consisted of 327,546 print monographs and 784,056 electronic books for a total of 1,111,602 titles. Of those, 76,968 bear the Library of Congress call numbers related to the study of Physics: Q, QA, QB, and QC. Additionally, the Library holds a collection of 349,749 physical and streaming audio/visual materials, 1,077 of which are especially relevant to Physics. Each year, a portion of the UTC Library's materials budget is allocated to purchase books, audio-visual materials, and other one-time resources. The FY2023 Library allocation for CAS is $109,070 out of a total budget of $334,205.

The free access that we have to ArXiv.org maintained by the Cornell University Library gives access to in excess of one million pre-prints in mathematics, computer science, physics, and related disciplines. Within physics it includes all the following areas.

- Astrophysics (**astro-ph** new, recent, find)

includes: Astrophysics of Galaxies; Cosmology and Nongalactic Astrophysics; Earth and Planetary Astrophysics; High Energy Astrophysical Phenomena; Instrumentation and Methods for Astrophysics; Solar and Stellar Astrophysics

- Condensed Matter (**cond-mat** new, recent, find)

includes: Disordered Systems and Neural Networks; Materials Science; Mesoscale and Nanoscale Physics; Other Condensed Matter; Quantum Gases; Soft Condensed Matter; Statistical Mechanics; Strongly Correlated Electrons; Superconductivity

- General Relativity and Quantum Cosmology (**gr-qc** new, recent, find)
- High Energy Physics - Experiment (**hep-ex** new, recent, find)
- High Energy Physics - Lattice (**hep-lat** new, recent, find)
- High Energy Physics - Phenomenology (**hep-ph** new, recent, find)
- High Energy Physics - Theory (**hep-th** new, recent, find)
- Mathematical Physics (**math-ph** new, recent, find)
- Nonlinear Sciences (**nlin** new, recent, find) includes:
  Adaptation and Self-Organizing Systems; Cellular Automata and Lattice Gases; Chaotic Dynamics; Exactly Solvable and Integrable Systems; Pattern Formation and Solitons
- Nuclear Experiment (**nucl-ex** new, recent, find)
- Nuclear Theory (**nucl-th** new, recent, find)
- Physics (**physics** new, recent, find) includes:
  Accelerator Physics; Atmospheric and Oceanic Physics; Atomic Physics; Atomic and Molecular Clusters; Biological Physics; Chemical Physics; Classical Physics; Computational Physics; Data Analysis, Statistics and Probability; Fluid Dynamics; General Physics; Geophysics; History and Philosophy of Physics; Instrumentation and Detectors; Medical Physics; Optics; Physics Education; Physics and Society; Plasma Physics; Popular Physics; Space Physics

- Quantum Physics (**quant-ph** new, recent, find)

Finally, we have a very well-functioning Interlibrary Loan System that is free to students and faculty. Electronic papers and books are usually available within a day to a few days. The resources of the library, including what is available through interlibrary loan are adequate for our teaching and research needs.

6. Support

6.1 The program's operating budget supports the needs of the program.

State operating budget has remained unchanged for the past ten years, at $75,160 (combined Chemistry and Physics). We are able to sustain our program needs for printing and duplicating, supplies, minor repairs, and hiring adjuncts and student workers.

Campus-wide, the lab fees collected have increased (doubled from $25/course to $50/course), enabling us to provide more support for the teaching laboratories. We have replaced all the hard drives in the physics labs (36 computers). We hire grading assistants and teaching assistants to support faculty who are teaching the physics and astronomy laboratories. Printer paper and printer supplies are being financed by lab fees to enable students to print their experimental procedures and lab reports. We are also able to purchase minor equipment (e.g. updated optics kits for each student group in the introductory labs).

In addition to the state budget funds indicated above, there are scholarship funds and physics program funds generated annually from endowments and donations. These funds have been used for student scholarships, student research support, faculty travel, and the purchase of minor equipment.

Physics Scholarship Funds (combined): $11,299 (AY23)

Physics Program Funds (combined): $16,847 (AY23)

In 2017 we were able to establish the Paul and Victoria Akins Endowed Student Research Scholarship in Chemistry and Physics. Funded by alumnus Dr. Paul Akins (CHEM ‘85) and his wife, Dr. Victoria Akins, the endowment began paying out in 2022 and Summer 2023 biophysics major Olivia Ziemer received support for her URP project. The current payout amount is $1,461 annually (not included in the above total).

The physics program has benefited from joining the Chemistry Department as we are now able to provide major scholarships (Westbrook) and equipment support (Grote) from large endowments.

Westbrook Scholarship Fund (combined Chemistry and Physics): $142,812 in FY24

Grote Fund (combined Chemistry and Physics): $216,965 in FY24

While the funds have been adequate to sustain the program, we need supplementary funds in order to grow with the new campus quantum initiative attracting more students and providing more research opportunities.

6.2 The program has a history of enrollment and/or graduation rates sufficient to sustain high quality and cost-effectiveness.

The introduction to this report described the enrollment numbers for physics programs nationwide, in which we are slightly below average (5 vs 4.6 graduates per year). In the state of Tennessee there are currently 21 recognized college physics programs. Five schools have graduate programs, but UTC's is strictly an undergraduate B.S. program. Of the 16 undergraduate-only programs in the state, the 2019 AIP report revealed that 12 have fewer majors than UTC and **just three** have more majors. Within a 50-mile radius, UTC awards more degrees and has more upper-division students than Southern Adventist and the University of the South.

The table below shows that of the 20 institutions in Tennessee that award a physics B.S. degree, our program ranks tenth in number of graduates averaged over the last five years.

Table 6.2 Physics Graduates from Tennessee Universities, 2018 – 2022.

Institution	Highest Physics Degree Offered	2017-18 Physics Bachelors	2018-19 Physics Bachelors	2019-20 Physics Bachelors	2020-21 Physics Bachelors	2021-22 Physics Bachelors	5 Year Average Graduates
TN-U of, Knoxville	PhD	14	16	32	31	18	22.2
Middle Tennessee St U	BS	19	10	10	20	9	13.6
Vanderbilt U	PhD	8		14		13	11.7
Rhodes Coll	BS	13	12	7	8	10	10.0
South-U of the	BS		5	8		8	7.0
Memphis-U of	PhD	6	4	4	6	12	6.4
Austin Peay St U	BS	8	6	7	5	5	6.2
East Tennessee St U	BS	7	4	5	3	9	5.6
Trevecca Nazarene U	BS	3	9	4			5.3
TN-U of, Chattanooga	***BS***	***9***	***2***	***4***	***6***	***2***	***4.6***
Belmont U	BS				6	3	4.5
King U	BS	4	2	3	1	4	2.8
Tennessee Tech U	BS	1	3	3	2	3	2.4
Carson-Newman U	BS		4	4	0	1	2.3
Lipscomb U	BS	2	2	3	1	2	2.0
Union U	BS	4			1	1	2.0
Southern Adventist U	BS	3	2	1	0	1	1.4
Christian Brothers U	BS	3	1	2	0	0	1.2
Fisk U	MS		---	1			1.0
Lane Coll	BS	0	2	0	0	0	0.4
TN-U of, Space Inst	PhD	GRADUATE ONLY					
		Source:	https://www.aip.org/statistics/rosters/physics				

6.3 The program is responsive to local, state, regional, and national needs.

Campus Needs

In order to improve our contact with our alumni and other supporters of the department, we have re-established an annual newsletter, created a LinkedIn alumni group, and increased our social media activity (Facebook, Twitter, Instagram). We hold an annual alumni reception on campus alongside our URP poster session.

We applied for and were approved to establish a Residential Learning Community, (MOCS in STEM) together with Chemistry and Math programs, to improve enrollment and freshmen retention of our majors.

To attract more transfer students, we have converted the existing Marlowe Family Physics Award into the Marlowe Transfer Scholarship.

We have developed a "transfer clear path" to ensure that transfer students can complete their degree in two years at UTC.

We revitalized the UTC Society of Physics Students (SPS) Chapter (faculty advisor - Dr. Allen). The Chapter has been dormant since the retirement of the previous faculty advisor, Dr. Marlowe, followed by the COVID pandemic. During 2021-22 academic year, the Chapter has received "Distinguished" standing by SPS National.

Dr. Hamblen participated in the American Physics Society Career Mentoring Program and visited Chattanooga State Community College to talk about Physics Careers and attract transfer students.

Local Needs

To support our STEM activities in the community, we have revitalized our relationship with the Barnard Astronomical Society, the local amateur astronomy club that built the Clarence T. Jones Observatory in 1937. We formed an Observatory Advisory Board and have upgraded the

facilities at the Observatory, including the addition of smart boards, a state-of-the-art planetarium projector, and an accessibility ramp.

State Needs

To address the statewide need to increase the number of qualified physics instructors at secondary schools, Drs. Allen and Hamblen put together a grant proposal in 2019 in collaboration with Dr. Jennifer Ellis, the Director of the STEM Education Program at UTC. The grant was submitted to the Physics Teacher Education Coalition (PhysTEC) and focused on recruiting students to our Physics: STEM Education degree concentration. Although the grant was not funded, UTC was accepted as a PhysTEC member institution.

National Needs

In 2022, UTC launched an institutional initiative in Quantum Information Science and Technology (QIST) with the goal to establish a program known for excellence in education, innovation, and economic development enabled by Quantum Technology (QT). Faculty members in the Physics Program are leading the initiative efforts. Based on progress (staffing, research, curriculum development, etc.) achieved to date, we are enroute to evolve the initiative into a Quantum Center within the UTC Research Institute. The initiative is the focal point for cross-disciplinary teams performing applied research and development (R&D) and delivering an effective education program of great value to students and individuals already in the workforce. Of particular interest are use cases of QT in advanced energy systems, and in smart city applications.

Part of the UTC Quantum R&D and educational infrastructure is a lab located on the UTC campus, connected to the EPB Quantum Network powered by Qubitekk. Dr. Li supervises the daily activities and is leading quantum networking research in this lab. This lab is equipped with a Quantum Network Interface Console, an 8-channel Superconducting Nanowire Single-Photon Detector (SNSPD), 3 quantum entanglement sources (two at 1570 nm, one at 810 nm), and optical hardware for quantum optics experiments both at 810 nm and 1570 nm. The EPB's commercial quantum network is designed not only for the private sector, but also for government and university researchers, to test their quantum devices and implementations in a deployed fiber-optic environment. Capable of generating, distributing, and measuring photonic qubits

among multiple users, the network exhibits a scalable architecture that can expand to include more users and resources to quickly incorporate the developed quantum devices. EPB and Qubitekk have already deployed three metro-scale quantum nodes in downtown Chattanooga, and are currently building a fourth one on the UTC campus, which is scheduled to be fully functioning in January 2024.

The initiative has strong ties to Departments and Programs in STEM (e.g., Physics, Mathematics, Electrical Engineering, Computer Science and Engineering) and non-STEM (e.g., Communications, Sociology, Economics, Entrepreneurship), and it will also advance collaborations with partners in the Chattanooga ecosystem such as EPB, Blue Cross Blue Shield of TN, Unum, and Volkswagen, in academia such as Chattanooga State Community College and Dalton State College, and national labs such as the nearby Oak Ridge National Laboratory. The City of Chattanooga also launched activities to advance economic development under the umbrella “Gig City Goes Quantum”. UTC is a key member of the Chattanooga Quantum Collaborative, led by Charlie Brock, a successful investor and entrepreneur. The Company Lab start-up accelerator has already included QT in their technical focus areas.

The initiative also launched a four-course QIST certificate program, which is aimed at upskilling non-advanced-degree holding professionals or non-physicists in the art of QIST with particular focus placed on quantum computation, both its hardware and software.

With all the activities enabled by the UTC Quantum Initiative, we believe it will significantly increase the enrollment as well as the retention rate of the Physics program.

Appendices

1. **Program Outcomes Assessment Reports**
2. **Four Year Course Schedule**
3. **Physics Curriculum Map**
4. **ASTR, GNSC, and PHYS course syllabi**

FY 2018-19 / ASSESSMENT PLAN

1. Demonstrate knowledge and competence

This view always presents the most current state of the plan item.
Plan Item was last modified on 10/8/19, 2:23 PM
Your individual permission settings determine what fields and content are visible to you.

Template:

Student Learning Outcome

Department/Degree Major:

BS Physics

Student Learning Outcome Title:

1. Demonstrate knowledge and competence

Student Learning Outcome Description:

Students demonstrate both knowledge and competence in understanding and applying fundamental laws of physics to specific natural phenomena in five key topic-area fields of physics: (i) classical mechanics, (ii) electricity and magnetism, (iii) thermal physics, (iv) modern physics including relativity and quantum mechanics, and (v) experimental methods.

Reporting Cycle Outcome Last Assessed:

Means of Assessment:

Rubric (Direct)

If Means of Assessment is "Rubric," please attach the file:

Attached Files

Rubric_Submitted.docx

If Means of Assessment is "Other," please specify:

If Means of Assessment is "Embedded Coursework," please list the course:

PHYS 3980 - Methods of Experimental Physics I

Course(s) Associated with SLO:

PHYS 1030
PHYS 1040
CHEM 1110(L)
CHEM 1120(L)
MATH 1950
MATH 1960
MATH 2200
PHYS 2300(L)
PHYS 2310(L)
PHYS 2320(L)
PHYS 3410(R)
PHYS 3420(R)
PHYS 3980(L)
PHYS 3990(L)
PHYS 4110

Attached Files
There are no attachments.

Relation of Means of Assessment to the Outcome:

Criteria for Success:

75% of students meet or exceed the student learning outcome standard outlined in the rubric for PHYS 3980.

Attached Files
There are no attachments.

Assessment Data (Results):

I assessed the student learning outcome in PHYS 3980 during the Fall 2018 semester through the setup, execution, and final report of the Simple Pendulum at Large Angle lab. The assessment was done via the above provided rubric. Assessment results are in the following file.

Student	Carry Out Experiment	Develop Mathematical Model	Analyze Data and Compare to Model	Draw Conclusions	Rubric Total Score	Outcome
A	1	0	1	0	2	Does Not Meet
B	1	1	1	1	4	Meets
C	2	2	2	2	8	Exceeds
D	2	2	1	1	6	Meets
E	1	2	2	2	7	Exceeds

Attached Files

Assessment_Data_Submitted.xlsx

Analysis and Interpretation of Results:

Attached Files
There are no attachments.

Follow Up Actions Planned :

As shown, 80% of students either met or exceeded the learning outcome standard, which satisfies the stated goal of at least 75% of students meeting or exceeding this standard.

A planned follow up action is to use this rubric to evaluate the student learning outcome in more than one laboratory exercise. This will give students more of an opportunity to demonstrate their overall competence in the outcome. Furthermore, the rubric seems well-suited to evaluate students on this outcome, since it focuses on the data collection, data analysis, comparison to mathematical models, and conclusions and suggested modifications. These core ideas are at the heart of this Methods of Experimental Physics I course.

The one student that did not meet the standard mainly was not prepared as well as the other students on the day of the lab exercise. In addition, the student did not allow enough time to finish the report and put adequate thought into the results and conclusions part of the report. Overall, the biggest difficulty in this lab is the development of the mathematical model with which the data is compared. As a result, it is also suggested to spend additional dedicated time in class to review the necessary mathematical techniques needed to evaluate the experimental data.

Attached Files
There are no attachments.

Continuous Improvement:

Feedback for Current Reporting Cycle:

Progress:

Ready for Review

Related Items

No connections made

FY 2019-20 / ASSESSMENT PLAN

4. Appropriate Laboratory Skills

This view always presents the most current state of the plan item.
Plan Item was last modified on 9/28/20, 9:55 AM
Your individual permission settings determine what fields and content are visible to you.

Template:

Student Learning Outcome

Department/Degree Major:

BS Physics

Student Learning Outcome Title:

4. Appropriate Laboratory Skills

Student Learning Outcome Description:

Students show appropriate laboratory skills drawn from experiencing a variety of important experiments at appropriate levels which illustrate phenomena discussed in the lecture classes. These skills will include a working knowledge of instrumentation and experimental techniques, and methods for quantitative analysis of data and measurement uncertainty.

Reporting Cycle Outcome Last Assessed:

Means of Assessment:

Rubric (Direct)

If Means of Assessment is "Rubric," please attach the file:

Attached Files

Rubric_Submitted.docx

If Means of Assessment is "Other," please specify:

If Means of Assessment is "Embedded Coursework," please list the course:

Course(s) Associated with SLO:

MATH 1950
MATH 1960
PHYS 2300(L)
PHYS 2310(L)
PHYS 2320(L)
PHYS 3980(L)
PHYS 3990(L)
Attached Files
There are no attachments.

Relation of Means of Assessment to the Outcome:

A rubric is used that individually evaluates student performance in the following key areas: setting up and operating the experiment, collecting data, analyzing data and obtaining results, and evaluating uncertainty of data and results. This method will directly assess overall student performance in the outcome.

Criteria for Success:

75% of students meet or exceed the student learning outcome standard outlined in the rubric for PHYS 3990.

Attached Files
There are no attachments.

Assessment Data (Results):

I assessed the student learning outcome in PHYS 3990 during the Fall 2019 semester via the above provided rubric. Assessment results are in the following attached file and also copied here.

	Set Up and Operate Instrument		Collect Quality Data		Analyze Data and Obtain Results		Measure and Assess Uncertainty			
Student (Initials)	Single Photon	Photoelectric Effect	Single Photon	Photoelectric Effect	Single Photon	Photoelectric Effect	Single Photon	Photoelectric Effect	Rubric Total Score	Outcome
JB	1	2	1	2	2	1	2	0	11	Meets
SB	1	2	1	2	2	2	2	2	14	Exceeds
BB	1	1	1	1	2	1	1	1	9	Meets
CB	1	2	1	2	0	0	0	0	6	Does Not Meet

JC	2	1	2	1	0	1	0	0	7	Does Not Meet
MG	2	2	2	1	1	1	1	1	11	Meets
RG	1	2	1	2	1	1	1	0	9	Meets
HH	1	2	1	2	1	1	1	1	10	Meets
NH	2	2	2	2	2	2	2	1	15	Exceeds
AK	2	2	2	1	1	1	1	1	11	Meets
SM	1	2	1	2	2	2	1	1	12	Meets
JO	1	2	1	2	1	2	1	1	11	Meets
BS	2	2	2	2	2	1	2	1	14	Exceeds
Average	1.38	1.85	1.38	1.69	1.31	1.23	1.15	0.77	10.77	

Attached Files

Assessment_Data_Submitted.xlsx

Analysis and Interpretation of Results:

None.

Attached Files
There are no attachments.

Follow Up Actions Planned :

As shown, 12 out of 14 students (86%) either met or exceeded the learning outcome standard, which satisfies the stated goal of at least 75% of students meeting or exceeding this standard. Furthermore, 3 out of 14 students (21%) exceeded the standard.

Although the standard was met, the rubric revealed a couple of key places where improvements can be made. For one, the Single Photon experiment had a lower average score in the “Set up and Operate” and “Collect Quality Data” components. The Single Photon experiment is the most difficult lab we have for students to set up and operate, and students were often not prepared at the beginning of the lab. A planned follow-up action is to give a pre-lab assignment to make sure that students come to class having read the lab materials and are fully prepared.

Additionally, the “Measure and Assess Uncertainty” rubric component had the lowest average score by far for both experiments in the entire rubric. An additional follow-up action is to stress to the students that they must record measurement uncertainties as well as calculate the uncertainty in their final values. The lab manual will be modified to state this as well.

A general improvement to how this outcome can be assessed it to perform the rubric assessment on more than two (or even all) of the experiments next time. Additionally, due to equipment limitations, students are required to work in groups of 3 or 4, so not everyone took an active role in performing the experiments. The next time the class is offered I will make sure everyone is fully participating and not just hanging back while more motivated students do the bulk of the work.

Attached Files
There are no attachments.

Continuous Improvement:

There are no previous assessment results. The results presented here are the initial ones.

Feedback for Current Reporting Cycle:

Progress:

Ready for Review

Related Items

No connections made

FY 2020-21 / ASSESSMENT PLAN

3. Problem Solving Skills

This view always presents the most current state of the plan item.
Plan Item was last modified on 8/3/21, 10:16 AM
Your individual permission settings determine what fields and content are visible to you.

Template:

Student Learning Outcome

Department/Degree Major:

BS Physics

Student Learning Outcome Title:

3. Problem Solving Skills

Student Learning Outcome Description:

Students demonstrate competence in problem solving skills and relevant mathematical methods; that is, they will be able to conceptualize and achieve analytical or numerical solutions to physics problems within important sub-categories of the five topic-areas referred to in LO(1).

Academic/Fiscal Year Outcome Last Assessed:

2017-2018

Means of Assessment:

Oral defense/Presentation, Rubric,

If Means of Assessment is "Rubric", please attach the file:

Attached Files

['.}Rubric Submitted.docx

If Means of Assessment is "Other," please specify:

Relation of Means of Assessment to the Outcome:

I chose to evaluate this outcome by having the students work on an individual project of their choosing. The students developed a python coding simulation that investigates their topic, wrote a document that outlines their project, and then they delivered an oral presentation to the class where they lead their classmates through the simulation. Each student works through the simulation from their computer while the presenter provides help and answers questions from students as needed. Upon completion of the project, each student should become competent in the problem-solving skills described in the learning outcome. The outcome was assessed by means of the rubric attached in the previous section.

Course(s) associated with SLO:

CHEM 1110(L)
CHEM 1120(L)
MATH 1950
MATH 1960
MATH 2200
MATH 2450
MATH 2550
PHYS 2300(L)
PHYS 2310(L)
PHYS 2320(L)
PHYS 3410(R)
PHYS 3420(R)
PHYS 3980(L)
PHYS 3990(L)

PHYS 4110
PHYS 4250

Attached Files
There are no attachments.

If Means of Assessment is "Embedded Coursework," please list the course:

Criteria for Success:

The criteria for success is that 100% of students meet the student learning outcome standard that is outlined in the rubric for PHYS 4250 and 50% of students exceed the student learning outcome standard. The rubric is used to evaluate a student's work in developing an individual project and presenting their work to the class. (It is attached above.)

This assessment was also last performed in Spring 2018 for PHYS 4250, so I would like to focus on the follow-up actions that were planned and submitted in that report in order to ensure success. These include having students start thinking about and working on their projects earlier in the semester as well as for the instructor to check in with students more regularly in order to monitor their progress.

Attached Files
There are no attachments.

Assessment Data (Results):

The rubric data for each student is presented below. The final results are that 100% of students met the student learning outcome standard, and 55% of students exceeded the student learning outcome standard. These results meet the criteria for success outlined above.

Rubric Component:

Student	1. Project Choice	2. Consulted with Instructor	3. Document Complete	4. Quality of Code	5. Presentation to Class	Rubric Total Score	Outcome
JB	2	2	2	2	2	10	Exceeds
GB	1	1	2	2	2	8	Exceeds
SB	2	2	2	2	2	10	Exceeds
EC	2	2	2	2	2	10	Exceeds
LG	1	1	1	1	1	5	Meets
RG	2	2	2	2	2	10	Exceeds
NH	2	2	2	2	2	10	Exceeds
KK	1	2	2	1	1	7	Meets
AK	2	1	2	1	1	7	Meets
IT	2	2	1	1	1	7	Meets
AV	1	1	2	1	1	6	Meets

Final Results:
11 out of 11 students (100%) met the student learning outcome standard
6 out of 11 students (55%) exceeded the student learning outcome standard

Attached Files
There are no attachments.

Status and improvements made during the Fiscal Cycle :

N/A

Attached Files

There are no attachments.

Follow Up Actions Planned:

The criteria for success was achieved, so no other follow-up actions are planned. Since this assessment was based on follow up actions from the 2017-2018 assessment cycle, I would like to evaluate a different outcome and course in the next academic year.

Attached Files
There are no attachments.

Continuous Improvement:

I implemented the follow up actions I had planned from the previous assessment cycle. The first action was having students begin thinking about their project idea earlier in the semester. Their project idea needed to be approved by March 16 this year compared to the previous deadline of March 29 in 2018. The earlier deadline did help students as it provided more time for them to formulate their project while also reducing the amount of hurried or last minute work in completing their projects.

I also made a conscious effort to check in with each student to get status updates on their projects during class. This had mixed success since this was a completely online - synchronous course modality during the pandemic. One on one interactions and providing assistance to students was more difficult than having the instructor walking around and assisting students in a computer lab during a normal year. In this modality it was easier for students to be less engaged at times in the class through Zoom.

But overall, the criteria for success was met, no one achieved a zero in any rubric category, and everyone presented their project on time, which is a definite improvement from the previous assessment in 2018. I will be sure to keep using these improvements the next time I teach the course.

Start (DO NOT CHANGE):

7/1/2020

End (DO NOT CHANGE):

6/30/2021

Progress:

Completed - Ready for Review

Responsible Roles:

Related Items

No connections made

FY 2020-21 / ASSESSMENT PLAN

Develop recruitment and retention plan

This view always presents the most current state of the plan item.
Plan Item was last modified on 8/3/21, 10:16 AM
Your individual permission settings determine what fields and content are visible to you.

Template:

Service Outcome

Department:

BS Physics

Title:

Develop recruitment and retention plan

Department Goal (Long-term):

Write a recruitment and retention plan.

Linked Documents
There are no attachments.

Outcomes Expected (including targets):

Academic/Fiscal Year Outcome Last Assessed:

This was a new outcome, so not previously assessed.

Strategies:

Means of Assessment:

Other

Relation of Means of Assessment to the Outcome:

If Means of Assessment is "Area Impacted", please specify:

If Means of Assessment is "Other", please give description:

Write a recruitment and retention plan that includes update the Department website, Institute new freshman mentorship program, work with High School Liaison committee, develop multiple scholarship committees to maximize our dollars for student awards and scholarships, student research and travel for presentation, work with student groups to create team-building type student-faculty activities.

If Means of Assessment is "Rubric", please attach file:

Attached Files
There are no attachments.

Criteria for Success:

Completed retention and recruitment plan.

Attached Files
There are no attachments.

Assessment Data (Actual Results):

Recruitment and retention plan was written. See attached document.

Attached Files

2021-2022 Physics Recruitment And Retention.docx

Actions Taken and Improvements Made During the Fiscal Year:

Attached Files

There are no attachments.

Follow Up Actions Planned:

The physics program will begin taking action on the steps in the plan.

Attached Files

There are no attachments.

Continuous Improvement:

This was a new outcome, so not previously assessed.

Start (DO NOT CHANGE):

7/1/2020

End (DO NOT CHANGE):

6/30/2021

Progress:

Completed - Ready for Review

Responsible Roles:

Related Items

No connections made

2021-2022 / ASSESSMENT PLAN

6. Written and Oral Communication Skills

This view always presents the most current state of the plan item.
Plan Item was last modified on 6/12/23, 11:27 AM
Your individual permission settings determine what fields and content are visible to you.

Template:

Student Learning Outcome

Department/Degree Major:

BS Physics

Student Learning Outcome Title:

6. Written and Oral Communication Skills

Student Learning Outcome Description:

Students demonstrate written and oral communication skills for dissemination of scientific results in reports, articles, or oral presentations, making use of standard citation methods. They will be aware of the importance of ethics to scientific inquiry and professionalism.

Reporting Cycle Outcome Last Assessed:

New (has not been previously assessed)

Means of Assessment:

Oral defense/Presentation (Direct), Rubric (Direct)

If Means of Assessment is "Rubric," please attach the file:

Attached Files

Rubric_Submitted.docx

If Means of Assessment is "Other," please specify:

If Means of Assessment is "Embedded Coursework," please list the course:

Course(s) Associated with SLO:

CHEM 1110(L)
CHEM 1120(L)
ENGL 2820
Oral Communications (e.g. THSP 1090)
PHYS 2300(L)
PHYS 2310(L)
PHYS 2320(L)
PHYS 3980(L)
PHYS 3990(L)
ASTR 4010

Attached Files
There are no attachments.

Relation of Means of Assessment to the Outcome:

I taught ASTR 4010 – Solar System Astrophysics during the Spring 2022 semester. I had students do a project where they choose an appropriate astrophysical topic, write a short paper, and deliver a presentation to the class. The topic was required to be approved by the instructor and also relate to the material we discussed in class. Special emphasis was given to ethics and professionalism in completing the project as well as references to articles from peer-reviewed journals. This makes the class ideal for evaluating Student Learning Outcome 6 – Written and Oral Communication Skills. The outcome was assessed by means of a rubric attached in the previous section.

Criteria for Success:

The criteria for success is that 100% of students meet the student learning outcome standard that is outlined in the rubric for ASTR 4010 and 50% of students exceed the student learning outcome standard. The rubric is used to evaluate a student's work in

developing an individual project and presenting their work to the class.

Attached Files
There are no attachments.

Assessment Data (Results):

Full assessment data is in the attached spreadsheet. The data show that 8 out of 9 students (89%) met the student learning outcome standard while 5 out of 9 students (56%) exceeded the student learning outcome standard.

These results meet one of my criteria for success (50% of students exceed the standard) while falling just short of the other criteria for success (100% of students meet the standard).

Overall, the students showed strengths in citing the works used in their presentations and also answering questions from the audience. Some weaknesses that need improvement from the students include making sure that everyone is present and actively participating in the discussion of each presentation, and some students needed to do a little more work on their papers to make sure they are clear and of professional quality.

Attached Files

AssessmentData_Submitted.xlsx

Analysis and Interpretation of Results:

This is the first time we are assessing this student learning outcome in the physics program. I chose to assess this outcome for that very reason (never been evaluated before) and also since being proficient in written and oral communication is an incredibly important skill for students to master while at UTC. It was straightforward to implement a presentation and paper component into my ASTR 4010 course and evaluate these skills via a rubric. Given the initial results from this assessment, I have provided my follow up actions in the following section that will be implemented the next time we assess this outcome.

Attached Files
There are no attachments.

Follow Up Actions Planned :

The assessment was partially successful. Over 50% of the students exceeded the standard I have established in the rubric, which meets one of the criteria for success. However, only 89% of the students met the established standard, which fell short of the 100% goal. The main reason is that one student did not do the paper and presentation project at all despite multiple attempted communications.

One followup action based on these results is to revise the criteria for success, such as setting the goal at 80% of students meeting the standard, which will remove an outlier data point from an unresponsive student. I have also come up with the following refinements to this assessment process which will ensure greater student success:

- Referring unresponsive students to UTC Student Outreach and Support
- Use the similarity score feature in Canvas so that students can see how original their submitted paper is, and encourage them to revise the text or quote/cite sources as needed.
- Encourage the students to practice their presentations several times before coming to class. Some students were either well under or well over their allotted time.
- Take extra time in class to discuss how to cite sources, or require students to attend a regularly held seminar in the library on this topic.

Attached Files
There are no attachments.

Continuous Improvement:

N/A

Feedback for Current Reporting Cycle:

Progress:

Ready for Review

Related Items

No connections made

2021-2022 / ASSESSMENT PLAN

Develop clear purpose and intent of program

This view always presents the most current state of the plan item.
Plan Item was last modified on 10/3/22, 9:18 AM
Your individual permission settings determine what fields and content are visible to you.

Template:

Service Outcome

Department:

BS Physics

Title:

Develop clear purpose and intent of program

Department Goal (Long-term):

Rewrite the department learning objectives for the Physics program

Linked Documents
There are no attachments.

Outcomes Expected (including targets):

Rewrite the department learning objectives for the Physics program

Reporting Cycle Outcome Last Assessed:

2020-2021

Strategies:

Means of Assessment:

If Means of Assessment is "Area Impacted," please specify:

If Means of Assessment is "Other," please give description:

Completion of rewriting the department learning objectives for the Physics program

If Means of Assessment is "Rubric," please attach file:

Attached Files
There are no attachments.

Relation of Means of Assessment to the Outcome:

Criteria for Success:

The department learning objectives for the Physics program are rewritten.

Attached Files
There are no attachments.

Assessment Data (Results):

The Physics Program Student Learning Outcomes were discussed and rewritten.

Current:

Physics Program Student Learning Outcomes

1. Demonstrate Knowledge and Competence: Students demonstrate both knowledge and competence in understanding and applying fundamental laws of physics to specific natural phenomena in five key topic-area fields of physics: (i) classical mechanics, (ii) electricity and magnetism, (iii) thermal physics, (iv) modern physics including relativity and quantum mechanics, and (v) experimental methods.
2. Critical Thinking: Students are able to use critical thinking, hypothesis building, and application of the scientific method to physics concepts, theoretical models and calculations, and laboratory experimentation.
3. Problem Solving Skills: Students demonstrate competence in problem solving skills and relevant mathematical methods; that

is, they will be able to conceptualize and achieve analytical or numerical solutions to physics problems within important sub-categories of the five topic-areas referred to in LO(1).
4. Appropriate Laboratory Skills: Students show appropriate laboratory skills drawn from experiencing a variety of important experiments at appropriate levels which illustrate phenomena discussed in the lecture classes. These skills will include a working knowledge of instrumentation and experimental techniques, and methods for quantitative analysis of data and measurement uncertainty.
5. Knowledge of Contemporary Areas of Physics: Students have a knowledge of contemporary areas of physics inquiry, as introduced in upper-level physics and interdisciplinary elective courses, as well as in faculty-mentored undergraduate research, which is available to all majors who seek this experience.
6. Written and Oral Communication Skills: Students demonstrate written and oral communication skills for dissemination of scientific results in reports, articles, or oral presentations, making use of standard citation methods. They will be aware of the importance of ethics to scientific inquiry and professionalism.
7. Ethical Behavior: Students will be able to explain why ethical behavior is essential to scientific inquiry and professionalism.

Attached Files
There are no attachments.

Analysis and Interpretation of Results:

Proposed (draft):

Physics Program Student Learning Outcomes

1. Demonstrate Knowledge and Competence: Students demonstrate both knowledge and competence in understanding and applying fundamental laws of physics to specific natural phenomena in five key topic-area fields of physics: (i) classical mechanics, (ii) electricity and magnetism, (iii) thermal physics, (iv) modern physics including relativity and quantum mechanics, and (v) experimental methods, as introduced in upper-level physics and interdisciplinary elective courses, as well as in faculty-mentored undergraduate research, which is available to all majors who seek this experience.
2. Critical Thinking: Students are able to use critical thinking, hypothesis building, and application of the scientific method to physics concepts, theoretical models and calculations, and laboratory experimentation.
3. Problem Solving Skills: Students demonstrate competence in problem solving skills and relevant mathematical methods; that is, they will be able to conceptualize and achieve analytical or numerical solutions to physics problems within important sub-categories of the five topic-areas referred to in LO(1).
4. Appropriate Laboratory Skills: Students show appropriate laboratory skills drawn from experiencing a variety of important experiments at appropriate levels which illustrate phenomena discussed in the lecture classes. These skills will include a working knowledge of instrumentation and experimental techniques, and methods for quantitative analysis of data and measurement uncertainty.
5. Written and Oral Communication Skills: Students demonstrate written and oral communication skills for dissemination of scientific results in reports, articles, or oral presentations, making use of standard citation methods. They will be aware of the importance of ethics to scientific inquiry and professionalism.

Attached Files
There are no attachments.

Follow Up Actions Planned :

The program learning outcomes were rewritten after the departmental discussion as shown above. However, the exact wording was not finalized yet.

In 2022-2023, the assessment committees will finalize the outcomes and get them approved from the departmental meeting.

Attached Files
There are no attachments.

Continuous Improvement:

This was a new outcome, so not previously assessed.

Feedback for Current Reporting Cycle:

Progress:

Ready for Review

Related Items

No connections made

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Write a recruitment and reten-on plan that includes update the Department website, Ins-tute new freshman mentorship program, work with High School Liaison commi>ee, develop mul-ple scholarship commi>ees to maximize our dollars for student awards and scholarships, student research and travel for presenta-on, work with student groups to create team-building type student-faculty ac-vi-es.

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Completed reten-on and recruitment plan.

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2022-2023 / ASSESSMENT PLAN

Develop and Assess Effectiveness of Physics Department Action Team

This view always presents the most current state of the plan item.
Plan Item was last modified on 9/28/23, 3:26 PM
Your individual permission settings determine what fields and content are visible to you.

Template:

Service Outcome

Department:

BS Physics

Title:

Develop and Assess Effectiveness of Physics Department Action Team

Department Goal (Long-term):

The physics program at UTC will form a Department Action Team to make positive changes within the program.

Linked Documents
There are no attachments.

Outcomes Expected (including targets):

Form team and develop a plan of action to carry out.

Reporting Cycle Outcome Last Assessed:

New

Strategies:

The strategies we will take are as follows:

1. Apply for the American Physical Society grant to have two faculty (Allen and Hamblen) participate in the American Physical Society's Department Action Leadership Institute (DALI) to get training about institutional change and on forming an effective local team. The DALI group meets monthly with experts and participants around the country. We take the ideas we've learned and put them into practice with our local department action team.
2. Form the UTC Physics Departmental Action team. Make sure that it includes a diverse team that includes tenured/tenure-track faculty, staff, administrators, adjunct faculty, and students.
3. Hold regular monthly meetings.
4. Create an open and supportive environment where anyone can share their ideas freely.
5. Locate and reference the best practices of physics programs across the nation. (Such as those found in the ep3guide the SPIN-UP Report, the Phys21 Report, among others.)
6. Identify immediate goals to work on that lead to our over-arching goal of increasing the number of physics majors.
7. Create an action plan to achieve each goal.
8. Once a year, re-evaluate and re-formulate the goals.

Means of Assessment:

Other

If Means of Assessment is "Area Impacted," please specify:

If Means of Assessment is "Other," please give description:

Use "Strategies" as a to do list to evaluate progress.

If Means of Assessment is "Rubric," please attach file:

Attached Files
There are no attachments.

Relation of Means of Assessment to the Outcome:

Completing as many strategies mentioned above as possible will fulfill completion of this outcome.

Criteria for Success:

Use "Strategies" as a to do list to evaluate progress. Success is viewed as 70% of the to-do list accomplished during any

given cycle.

Attached Files
There are no attachments.

Assessment Data (Results):

Our results so far as we have worked to build and establish our physics department action team:

1. We applied for the American Physical Society grant and got funded to have two faculty (Allen and Hamblen) participate in the American Physical Society's Department Action Leadership Institute (DALI). DALI cohort 2 ran from Fall 2021 till Spring 2022, with occasional meetings during the 2022-23 academic year. We are still in contact and communication with the DALI leaders, Drs. David Craig and Joel Corbo.
2. We formed the local UTC Physics Departmental Action team in the Spring semester of 2022. Currently it includes tenured/tenure-track faculty (Dr. Allen, Dr. Hamblen, Dr. Li, Dr. Sanches Diaz), administrators (Dr. Dungey), staff (Mr. Pitkin), adjunct faculty (Mr. Stewart), and students (Ivy Cartwright and Olivia Denton).
3. During 2022-23 academic year we held eight monthly meetings
4. We did a special exercise to make sure that we create an open and supportive environment that anyone can share their ideas freely. We created a norms document and anonymous feedback form. (See attached file: UTC Physics DAT Norms.docx)
5. We performed a "Sticky notes" activity to identify the most important areas for improvement and associated goals for our program. (See attached file: Sorted Question Burst Activity.pptx)
6. The goal to work on during 2022-23 was to establish a new transfer student scholarship. This is the first part of a larger goal: to increase the number of majors in the program.
7. We have the following accomplishments:
    a. Performed a thorough self-study of our program. Where do our majors originate? Where do our majors go when they leave our program and change majors?
    b. Got a new physics major transfer scholarship up and running. (See attached file Marlowe Transfer Scholarship Webpage.pdf or https://www.utc.edu/marlowe for details.)
    c. Reached out to area community colleges to advertise transfer students opportunities at UTC and visited a physics class at Chattanooga State Community College.
    d. We believe that to improve the retention of our students, it is important to introduce them to the department during their first semester. Unfortunately, many freshmen don't yet satisfy the math pre-requisites to take their first "real" physics course in their first year. Therefore, we made the PHYS 1250 First Year Experience course required for all physics majors, so that they will have a course with a physics professor in their first semester.
    . Finally, we have developed a thorough department action plan which outlines all the major steps we'd like to take going forward. (See attached file UTC Physics DAT Action Plan.docx)

Attached Files

- Marlowe Transfer Scholarship Webpage.pdf
- Sorted Question Burst Activity.pptx
- UTC Physics DAT Action Plan.docx
- UTC Physics DAT Norms.docx

Analysis and Interpretation of Results:

We have had a productive first year in our department action team. We have formed a diverse team, developed a norms document which establishes our guidelines for discussion, put together an action plan, and have begun to carry it out by starting a transfer scholarship and also make our First Year Experience course required for all freshman physics majors.

Attached Files
There are no attachments.

Follow Up Actions Planned :

A meeting will be scheduled during the Fall of 2023 to re-evaluate and re-formulate the goals to go forward.
We will start early this academic year with the advertisement of the transfer scholarship so that we will have a large applicant pool and be able to award it.
We are working on establishing a new quantum degree concentration, which is aligned with UTC's large investment in the Chattanooga Quantum Initiative.

- We are working to add new a data analysis course for 1st (and 2nd) year physics majors.

Attached Files

There are no attachments.

Continuous Improvement:

We believe we have had a successful year and accomplished more than 70% of our plan.

Feedback for Current Reporting Cycle:

Progress:

Ready for Review

Related Items

No connections made

2022-2023 / ASSESSMENT PLAN

Develop clear purpose and intent of program by updating learning objectives

This view always presents the most current state of the plan item.
Plan Item was last modified on 9/28/23, 3:19 PM
Your individual permission settings determine what fields and content are visible to you.

Template:

Service Outcome

Department:

BS Physics

Title:

Develop clear purpose and intent of program by updating learning objectives

Department Goal (Long-term):

Rewrite the department learning objectives for the Physics program.

Linked Documents
There are no attachments.

Outcomes Expected (including targets):

Rewrite the department learning objectives for the Physics program.

Reporting Cycle Outcome Last Assessed:

New

Strategies:

The physics faculty will meet and discuss updating and streamlining the physics learning objectives. We will also develop a new curriculum map that shows where in our curriculum these objectives are introduced, practiced, and competency is observed.

Means of Assessment:

Other

If Means of Assessment is "Area Impacted," please specify:

If Means of Assessment is "Other," please give description:

Completion of rewriting the department learning objectives for the Physics program.

If Means of Assessment is "Rubric," please attach file:

Attached Files
There are no attachments.

Relation of Means of Assessment to the Outcome:

Completion of rewriting the department learning objectives fulfills this outcome.

Criteria for Success:

The department learning objectives for the Physics program are rewritten and new curriculum map produced.

Attached Files
There are no attachments.

Assessment Data (Results):

The physics faculty met at our Departmental Assessment Workshop in August and completed the outcome. See the updated student learning outcomes attached here, as well as the updated physics curriculum map.

Attached Files

Physics Curriculum Map 2023.xlsx

Program Student Learning Outcomes Physics 2023.docx

Analysis and Interpretation of Results:

The student learning outcomes will be used starting in the 2023-2024 academic year for our assessments going forward.

Attached Files

There are no attachments.

Follow Up Actions Planned :

We will follow our 3-year assessment plan which will evaluate each outcome over this time and also give each physics faculty member the opportunity to do an assessment. See the attached file.

Attached Files

Physics Program Assessment Plan 2023.docx

Continuous Improvement:

We have now finalized our student learning outcomes and updated our curriculum map accordingly. We have shown evidence of continuous improvement by developing a 3-year assessment cycle for these outcomes that will involve every physics faculty member over that time period.

Feedback for Current Reporting Cycle:

Progress:

Ready for Review

Related Items

No connections made

2022-2023 / ASSESSMENT PLAN

5. Knowledge of contemporary areas of physics

This view always presents the most current state of the plan item.
Plan Item was last modified on 11/9/23, 4:16 PM
Your individual permission settings determine what fields and content are visible to you.

Template:

Student Learning Outcome

Department/Degree Major:

BS Physics

Student Learning Outcome Title:

5. Knowledge of contemporary areas of physics

Student Learning Outcome Description:

Students have a knowledge of contemporary areas of physics inquiry, as introduced in upper-level physics and interdisciplinary elective courses, as well as in faculty-mentored undergraduate research, which is available to all majors who seek this experience.

Reporting Cycle Outcome Last Assessed:

New

Means of Assessment:

Rubric (Direct)

If Means of Assessment is "Rubric," please attach the file:

Attached Files

05 Physics PLO rubric.docx

If Means of Assessment is "Other," please specify:

If Means of Assessment is "Embedded Coursework," please list the course:

Course(s) Associated with SLO:

PHYS 2310(L)
PHYS 2320(L)
PHYS 3990(L)
PHYS 4110
PHYS 3420(R)
PHYS 4300(L)

Attached Files
There are no attachments.

Relation of Means of Assessment to the Outcome:

A rubric is used that individually evaluates student performance in the following key areas: understand and comprehend material, communicate in written form, apply material to solve a problem. This method will directly assess overall student performance in the outcome.

Criteria for Success:

The criteria for success is that 83% of students meet the student learning outcome standard that is outlined in the rubric for PHYS 4300/L and 50% of students exceed the student learning outcome standard. 13% do not meet the criteria. The rubric is used to evaluate a student's work in developing an individual project and write a report.
First time evaluating this assessment. In two years will reevaluate this outcome.

Attached Files
There are no attachments.

Assessment Data (Results):

The rubric data for each student is presented below. The results are that 83% of students met the student learning. outcome standard, and 50% of students exceeded the student learning outcome standard. 13% do not meet the criteria. These results meet the criteria for success outlined above.

Student	Understand and comprehend		Communicate in written form		Apply new material		Results
	MD lysozyme	Rheology BSA	MD lysozyme	Rheology BSA	MD lysozyme	Rheology BSA	
JB	2	1	2	2	2	1	10
EMT	1	1	1	1	1	1	6
KA	2	2	2	2	2	2	12
LA	1	2	1	2	2	2	10
MR	1	0	0	0	0	0	1
KW	2	1	2	0	2	0	7

Attached Files
There are no attachments.

Analysis and Interpretation of Results:

The data shows that 83% of students who met the outcome attend class regularly. 50% of the students who exceeded the outcome were involved in research. No changes were made during the reporting cycle. In conclusion, attendance is the best way to succeed in these outcomes. In two years, we are planning to use the same rubric to contrast with the current results.

Attached Files
There are no attachments.

Follow Up Actions Planned :

The criteria for success were achieved, so no other follow-up actions are planned. We will review the same outcome in two years.

Attached Files
There are no attachments.

Continuous Improvement:

There are no previous assessment results. The results presented here are the initial ones.

Feedback for Current Reporting Cycle:

Progress:

Ready for Review

Related Items

No connections made

Appendix 2. Four year course schedule for Physics, Astronomy, and General Science:

Physics and Related ASTR and GNSC Courses		F22	Sp23		F23	Sp24		F24	Sp25		F25	Sp26
Expected Schedule (subject to change as needed)												
PHYS 1030 /1030L Gen Physics I Mechanics and Heat		√	√		√	√		√	√		√	√
PHYS 1040 / 1040L - Gen Physics II - Electromagnetism and Optics		√	√		√	√		√	√		√	√
PHYS 2300 / 2300L - Principles of Physics - Mechanics and Heat		√			√			√			√	
PHYS 2310 /2310L - Principles of Physics - Electricity and Magnetism		√	√		√	√		√	√		√	√
PHYS 2320/2320L - Principles of Physics - Optics and Modern Physics			√			√			√			√
PHYS 3070 - Optics					√						√	
PHYS 3110 - Introduction to Thermal Physics		√						√				
PHYS 3180 - Radiation Physics and Introductory Health Physics												
PHYS 3410 - Classical Mechanics		√			√			√			√	
PHYS 3420 - Electricity and Magnetism			√			√			√			√
PHYS 3980 - Methods of Experimental Physics I		√						√				
PHYS 3990 - Methods of Experimental Physics II					√						√	
PHYS 4110 - Quantum Mechanics			√						√			
PHYS 4300 - Physics of Living Systems			√						√			
PHYS 4997r - Research		√	√		√	√		√	√		√	√
One of below on rotating basis (spring semester)						√			√			√
PHYS 3030 - Basic Electronics												
PHYS 4120 - Nuclear Physics												
PHYS 4140r - Advanced Modern Physics												
PHYS 4250 - Computer Science Materials Development												
ASTR 4010 Solar System Astrophysics												
Following as needed: PHYS 1999r - Special Projects		√										
PHYS 4000r - Physics Seminar,		√										
PHYS 4995r - Dept. Thesis, 4998r or 4999r - Individual or Group Studies												
ASTR 1010 - Intro to Astronomy The Solar System		√	√		√	√		√	√		√	√
ASTR 1020/1020L - Intro to Astronomy Stars to Galaxies		√			√			√			√	
GNSC 1110 / 1110L - The Physical Environment Atoms to Galaxies			√			√			√			√
GNSC 1150 - Science and Society		√	√		√	√		√	√		√	√

Last updated 09/09/2022 by J. Hamblen

Appendix 3. Example curriculum map for the physics program:

Curriculum Map B.S. Physics: Physics UTC Dept. of Physics and Chemistry Rev. 4/24/14

(L)=lecture and lab. (R)=lecture and recitation. I=subject matter/SLO introduced. P=subject matter/SLO practiced. C=competency achieved in SLO.

Student Learning Outcome: Courses	(1) … knowledge and competence in understanding and applying fundamental laws of physics ….	(2) … critical thinking, hypothesis building, and application of the scientific method …	(3) ... problem solving skills and relevant mathematical methods …	(4) ... appropriate laboratory skills …	(5)... knowledge of contemporary areas of physics ...	(6) ... written and oral communication skills …	(7) … ethical behavior essential to scientific inquiry …
CHEM 1110(L)	I, P	I, P	I, P			I, P	I
CHEM 1120(L)	I, P	I, P	I, P			I, P	I
MATH 1950	I, P		I, P	P			
MATH 1960	I, P		I, P	P			
MATH 2200	I, P		I, P				
MATH 2450			I, P				
MATH 2550			I, P				
ENGL 2820						I, P	
Oral Communications (e.g. THSP 1090)						I, P	
PHYS 2300(L)	I, P	I, P	I, P	I, P		I, P	I
PHYS 2310(L)	I, P	I, P	I, P	I, P	I	I, P	I
PHYS 2320(L)	I, P	I, P	I, P	I, P	I	I, P	I
PHYS 3410(R)	P, C	P, C	P, C				
PHYS 3420(R)	P, C	P, C	P, C		P		
PHYS 3980(L)	P, C	P, C	P, C	P, C		P, C	P, C
PHYS 3990(L)	P, C	P, C	P	P, C	P	P, C	P, C
PHYS 4110	P, C	P, C	P, C		P, C		

1) Students demonstrate both knowledge and competence in understanding and applying fundamental laws of physics to specific natural phenomena in five key topic-area fields of physics: (i) classical mechanics, (ii) electricity and magnetism, (iii) thermal physics, (iv) modern physics including relativity and quantum mechanics, and (v) experimental methods.

2) Students are able to use critical thinking, hypothesis building, and application of the scientific method to physics concepts, theoretical models and calculations, and laboratory experimentation.

3) Students demonstrate competence in problem solving skills and relevant mathematical methods; that is, they will be able to conceptualize and achieve analytical or numerical solutions to physics problems within important sub-categories of the five topic-areas referred to in LO(1).

4) Students show appropriate laboratory skills drawn from experiencing a variety of important experiments at appropriate levels which illustrate phenomena discussed in the lecture classes. These skills will include a working knowledge of instrumentation and experimental techniques, and methods for quantitative analysis of data and measurement uncertainty.

5) Students have a knowledge of contemporary areas of physics inquiry, as introduced in upper-level physics and interdisciplinary elective courses, as well as in faculty-mentored undergraduate research, which is available to all majors who seek this experience.

6) Students demonstrate written and oral communication skills for dissemination of scientific results in reports, articles, or oral presentations, making use of standard citation methods.

7) Students will be able to explain why ethical behavior is essential to scientific inquiry and professionalism.

The above curriculum map was in place during the review period: in Fall 2023 we revised our Program Learning Outcomes and updated the Physics Curriculum Map.

The University of Tennessee at Chattanooga

Introduction to Astronomy - The Solar System

Fall 2022

ASTR 1010, section 2, CRN 43500, online,3 credit hours

Instructor: Dr. Luis E. Sanchez-Diaz

Email and Phone Number: luis-sanchezdiaz@utc.edu, (423) 425-4546 and Zoom Meeting ID

Meeting ID: 958 619 9280

Passcode: Sc25R4

Office Hours and Location: Please email me or connect to zoom with your questions any time; I will respond within 24 hours. Virtual appointments are available as needed.

Course Meeting Days, Times, and Location: Online in UTC Learn. This course will be asynchronous. Logging into the course several times per week is very important for your success to access course content, communicate with your instructor, and complete course assignments. Slides, assignments, discussion forum and supplemental material will be posted on canvas at the beginning of the week. Tuesday and Thursday will be posted the video of the lecture, quizzes, and exam on canvas. See last page for schedule and due dates

Course Catalog Description: Descriptive and conceptual introduction to the nature and origin of the solar system. Topics include models of the night sky, natural laws describing celestial objects and light, telescopes, the Earth-Moon system, planets and satellites, and the Sun.

Course Pre/Co Requisites: None. Recommended laboratory: ASTR 1010L.

Course Student Learning Outcomes: In this course we wish to acquaint you with the current state of knowledge about our "astronomical backyard." We will discuss current theories regarding the origin and evolution of our solar system, the physical laws describing orbital motion, and comparative planetology. Throughout our historical and scientific journey, we will stress the physical principles which underlie our theories, that is, *how* do we know what we know? What are the uncertainties in our knowledge? Our study of this remarkably interdisciplinary field will include information which, in some cases, has only become available in the last few years. Many of the optional laboratory activities are designed to introduce you to some basic physical laws and their application to astronomy. Overall outcomes are:

- Explain intellectual foundations, conceptual approaches, and methodologies of the natural sciences.
- Understand and explain scientific terminology.
- Discuss historical, social and political issues related to scientific data and advances.

- Construct graphic and analytical models from a description of a specific natural phenomenon.
- Formulate a hypothesis based on empirical data.
- Apply the scientific method to solve problems.
- Design experiments to test hypotheses.
- Express conclusions and implications from scientific experiments using a variety of methods.

General Education Statement: ASTR 1010 is certified as a General Education course fulfilling 3 hours in the Natural Science Non-Laboratory (NS) category. If taken in combination with ASTR 1010L, these courses fulfill 4 hours in the Natural Science Laboratory (SL) category. See above for course learning outcomes.

Required Course Materials: Text: We will be using "*Astronomy: A Beginner's Guide to the Universe*", 8th Edition, by Chaisson and McMillan (Pearson Addison-Wesley, c. 2017). In general, we will cover Chapters 0-9. The remaining chapters detailing stars and galaxies are covered in ASTR 1020. **Scientific Calculator**: You will be allowed to use one, so own one and bring it. You should familiarize yourself with how to use scientific notation and trigonometric functions on it.

Technology Requirements for Course: Access to the internet for UTC Learn announcements. Scientific calculator.

Technology Skills Required for Course: Students should be able to use an internet-connected device and a scientific calculator.

Technology Support: If you have problems with your UTC email account or with UTC Learn (Canvas), contact IT Help Desk at 423-425-4000 or email helpdesk@utc.edu.

Student Technology: If you have technology needs to access your courses and/or complete course requirements in Canvas, submit a request (https://new.utc.edu/information-technology/learning-from-home) with Information Technology.

Student Accommodations: If you have accessibility and accommodation requests, contact the Disability Resource Center (https://www.utc.edu/disability-resource-center/index.php) at 423-425-4006 or email DRC@utc.edu.

Course Assessments and Requirements: The grading weights will be as follows:

(a) 3 exams (50% each)	= 50%
(b) Best 2 of 3 Quizzes	= 20
(c) Homework	= 20
(e) Discussion forum	= 10
	100%

Course Grading

Course Grading Policy: There will be 3 scheduled hourly exams during the semester, and 3 brief (15 min.) quizzes. **No extra credit work other than that provided on homework, quizzes, and exams may be done to substitute for low grades or missed homework, quizzes, or exams. No exceptions. Quizzes and exam will be posted in CANVAS**

Homework Instructions: Homework problems will consist of either discussion questions or problems involving a calculation. Answers to discussion questions must be written out neatly or typed using complete sentences. You must show all your work for problems that require a calculation. **Homework assignments will be posted in canvas and due dates will be announced on canvas.**

If you need help in completing an assignment, I will be glad to help you after you have made a reasonable effort to work them on your own. Visit me during my office hours or contact me to make an appointment.

Instructor Grading and Feedback Response Time: A *tentative* guide for the overall course grade will be: A ≥ 90 > B ≥ 80 > C ≥ 70 > D ≥ 60 > F. The total grade contribution for quizzes and homework will for each be a maximum of 100% (e.g., working extra credit problems for homework will not be allowed to bring the homework part of the total grade to greater than 100%). Graded assignments typically will be returned within one week.

Course and Institutional Policies

Late/Missing Work Policy: Please note that **it is the student's responsibility** to make up work as follows:

• Exams may only be retaken due to (a) illness (a doctor's excuse is required), or (b) a family emergency (verification will be required). Make-up exams must be scheduled within 3 days of the student's return to classes. Please note that my make-up exams are equal to or exceed the original exam in difficulty.

• Homework will be due in class on the assigned date. Assignments not received in class will be counted as late. Late assignments will be subject to a 20% penalty. Assignments submitted more than one week after the original due date **will not be accepted**.

• Quizzes which are missed cannot be made up.

Student Conduct Policy: UTC's Student Code of Conduct and Honor Code (Academic Integrity Policy) can be found on the Student Conduct Policy page (https://www.utc.edu/student-conduct/codes.php).

Honor Code Pledge: As a student of the University of Tennessee at Chattanooga, I pledge that I will not give or receive any unauthorized assistance with academic work or engage in any academic dishonesty in order to gain an academic advantage. I will exert every effort to insure that the Honor Code is upheld by myself and others, affirming my commitment to a campus-wide climate of honesty and integrity

Course Attendance Policy: Logging into the course several times per week is very important for your success to access course content, communicate with your instructor, and complete course assignments.

Course Participation/Contribution: You are expected to complete scheduled activities every week. You should log-in to the course regularly – several times per week, engage with the instructor and other students on discussion forums, read/view your weekly course content, take learning assessments as scheduled, and work on/submit your projects. You should expect to spend at least 12 hours per week on this course because this is an accelerated course.

During the communication on the different discussion forums, email, or zoom is expected the student follow the 7 rules for online etiquette:

1. Be respectful
2. **Be aware of strong language, all caps, and exclamation points**
3. **Be careful with humor and sarcasm**
4. **grammar and spelling matter.**
5. **Cite your sources.**
6. **Don't post or share (even privately) inappropriate material**
7. **Be forgiving.**

For details please visit the following link: https://achievevirtual.org/7-rules-for-online-etiquette/

Course Learning Evaluation: Course evaluations are an important part of our efforts to continuously improve the learning experience at UTC. Toward the end of the semester, you will receive a link to evaluations and are expected to complete them. We value your feedback and appreciate you taking time to complete the anonymous evaluations.

UTC Bookstore: The UTC Bookstore will price match Amazon and Barnes and Noble (https://www.barnesandnoble.com/) prices of the exact textbook - same edition, ISBN, new to new format, used to used format, and used rental to used rental format, with the same rental term. For more information, go to the Bookstore Price Match Program (https://bnc.pgtb.me/MMt77F), visit the bookstore, email sm430@bncollege.com or call 423-425-2184.

Course Calendar/Schedule: Here is schedule of lectures and test/quiz dates. **Students are expected to come to class with the assigned material read beforehand.'**

Tue. 08/23: Introduction; Discussion of Syllabus and Outcomes

Th. 08/25-Tue. 08/30: Ch. 0 Charting the Heavens: The Foundations of Astronomy (Read chapter 0 book)

Th. 09/01-Tue. 09/06: Ch. 1 The Copernican Revolution (Read chapter 1 book)

09/08 Homework 1 and discussion forum 1
09/08 Quiz 1

Th. 09/08-Tue. 09/13: Ch. 2 Light and Matter (Read chapter 2 book)

Th. 09/15-Tue. 09/20: Ch. 3 Telescopes (Read chapter 3 book)

09/22 Homework 2 and discussion forum 2

Th. 09/22 Exam 1

Tue. 09/27-Th. 09/29 : Ch. 4 The Solar System (Read chapter 4 book)

Tue. 10/04-Th. 10/06 Ch. 5 Earth and Its Moon Revolution (Read chapter 5 book)

10/06 Homework 3 and discussion forum 3

10/06 Quiz 2

Tue. 10/11-Th. 10/13 Ch. 6 The Terrestrial Planets (Read chapter 6 book)

Tue. 10/18 Fall break

Th. 10/20 Exam 2

Tue. 10/25-Th. 10/27: Ch. 7 The Jovian Planets (Read chapter 7 book)

10/28 Homework 4 and discussion forum 4

Tue, 11/01-Th. 11/03: Ch. 8 Moons, Rings, and Plutoids Revolution (Read chapter 8 book)

11/03 Quiz 3

Tue. 11/08-Th. 11/10: Ch. 9 The Sun (Read chapter 9 book)

11/11 Homework 5 and discussion forum 5

Tue. 11/15-Th. 11/17: Ch. 10 Measuring of the starts and Chapter 12 stellar evolution

Tue. 11/22-Th. 11/29: Ch. 13 Neutron starts and black holes
holes

12/01 Homework 6 and discussion 6

Th: 12/01 Exam 3

The University of Tennessee at Chattanooga

Astronomy Laboratory – The Solar System

Spring 2020

The Department of Chemistry and Physics

ASTR 1010L-0 CRN 209571 hr.
ASTR 1010L-1 CRN 21115 1 hr.

Instructor: Mr. Jack Pitkin

Phone and Email: (423)425-4518 Jack-Pitkin@utc.edu (Best way to get me)

Office Hours and Location: M-W 9:00AM-3:00 PM (also by appointment) Grote Hall 215A

Course Meeting Days, Time, and Location:

CRN 20957 T 5:00 PM-6:50 PM GROTE 217
CRN 21115 T 5:00 PM-6:50 PM GROTE 216

Course Catalog Description: Laboratory to accompany Astronomy 1010. Exercises include learning to set up and use a telescope, a deep sky observing session, a visit to *UTC* Jones Observatory and Planetarium, astrometry, and astro imaging. Spring semester. *Two hours per week. Co-requisite: Astronomy 1010 or permission of the head of the department.*

Course Pre/Co Requisites: Co-requisite: Astronomy 1010 or permission of the head of the department.

Course Student Learning Outcomes: Upon completion of the required credit hours in ASTR 1010 and 1010L, students will be able to meet the following outcomes as they apply to introductory astronomy:

- Explain intellectual foundations, conceptual approaches, and methodologies of astronomy.
- Understand and explain scientific terminology.
- Discuss historical, social and political issues related to scientific data and advances.
- Construct graphic and analytical models from a description of a specific natural phenomenon.
- Formulate a hypothesis based on empirical data.
- Apply the scientific method to solve problems.

• Design experiments to test hypotheses.

• Express conclusions and implications from scientific experiments using a variety of methods.

• Experience the methods and technology of scientific inquiry.

• Demonstrate significant concepts of the discipline.

• Use scientific technology to gather and interpret data.

•Practice the development of independent thought.

General Education Statement: Astronomy 1010 and 1010L together fulfill 4 credit hours of the general education requirement in Natural Science Laboratory (SL) courses.

Course Fees: $25.00 **********

Course Materials/Resources: UTC Astronomy 1010L Laboratory Manual. Weekly experiments are downloadable from the course website on Canvas. Also, a simple scientific calculator should be brought to each lab period.

Technology Requirements for Course: Simple Scientific Calculator

Technology Skills Required for Course: It will be helpful if you are comfortable with general computerized operations in a Windows 10 environment. It will also be helpful if you are proficient with spreadsheet software such as Excel. If you have not yet mastered Excel, you will be given plenty of help, encouragement, and opportunities to practice.

Technology Support: If you have problems with your UTC email account or with UTC Learn contact IT Solutions Center at 423-425-4000 or email itsolutions@utc.edu

Course Assessments and Requirements: The weighting of the overall course grade is tentatively set forth below; students will be notified in class if a reassignment of weights becomes necessary. Points will be based on a combination of Lab Experiments and Field Trips.

155 Points Maximum Possible

140-126 Points A

125-112 Points B

111-98 Points C

97-84 Points D

83 -0 Points F

Instructor Grading and Feedback Response Time: Every effort will be made to get each assignment graded, recorded on Canvas, and returned to the student. Records will be kept up to date on blackboard.

Student Conduct Policy: UTC's Academic Integrity Policy is stated in the Student Handbook.

Honor Code Pledge: I pledge that I will neither give nor receive unauthorized aid on any test or assignment. I understand that plagiarism constitutes a serious instance of unauthorized aid. I further pledge that I exert every effort to ensure that the Honor Code is upheld by others and that I will actively support the establishment and continuance of a campus-wide climate of honor and integrity.

Attendance Policy: Attendance in all Astr1010L lab sessions is ***mandatory***. Attendance will be recorded for all lab sessions, except for those students engaged in special studies as determined by the instructor. **Absence from more than 3 regularly scheduled laboratory sessions -- without prior permission from the lab instructor --will result in an F for the lab grade.**

Course Participation/Contribution: Unless otherwise noted, each person must submit his/her own lab report; the name of any lab partner(s) should be listed below the student's own name in the upper right corner of the front page.

Policy for Late/Missing Work: *Missed labs* must be rescheduled at the convenience of the instructor and any lab partners who may be necessary. If you must miss a lab session, that session should be made up as soon as possible. *Late lab reports* **will not be accepted without the instructor's prior permission and** will result in a grade of zero for that lab.

Course Calendar/Schedule: Lab manual: **UTC Astronomy 1010L Laboratory Manual** (downloadable from course website on Canvas as individual experiments) is required. Unless otherwise noted, each person must submit his/her own lab report; the name of any lab partner(s) should be listed below the student's own name in the upper right corner of the front page. With perhaps a few exceptions, you will have the description for each activity available to you beforehand; **for all such labs, you are expected to have read the lab manual description before coming to the lab session!!** Lab reports are due when specified.

Course Learning Evaluation: Course evaluations are an important part of our efforts to continuously improve the learning experience at UTC. Toward the end of the semester, you will receive a link to evaluations and are expected to complete them. We value your feedback and appreciate you taking time to complete the anonymous evaluations.

LAB EXPERIMENTS

Week	Date	Title
1.	1/09/2020	**Introduction to Lab and Clear Dark Sky Weather Forecast—10 points**
2.	1/16	**Hallo Northern Sky—10 points**
3.	1/23	**Telescope Lab-Polar Alignment, Altitude Azimuth, etc. Star Party Introduction---10 points**
4.	1/30	**Astro-Imaging Lab---10 points**
5.	2/6	**Gravity and Mass of the Earth—15 points**
6.	2/13	**Introduction to CLEA Labs and start The Moons of Jupiter**
7.	2/20	**CLEA Lab the Moons of Jupiter Finish—15 points**
8.	2/27	**Robotic Space Craft—10 points**
9.	3/5	**Kepler Transit Lab-15 Points**
10.	3/14	**Spring Break No Lab**
11.	3/19	**CLEA Lab Astrometry of Asteroids Start**
12.	3/26	**CLEA Lab Astrometry of Asteroids Finish-15 Points**
13.	4/2	**CLEA Lab Transit of Venus Start**
14.	4/09	**CLEA Lab Transit of Venus Finish-15 Points**
15.	4/22	**Last day of Spring Semester 2019 EVERYTHING DUE!!!!!!**

FIELD TRIPS

Deep Sky Observing!! The UTC Astronomy Department will be joining the Barnard Astronomical Society for a joint public star party at Harrison Bay State Park. We will spend a fascinating night viewing a host of celestial objects. The members of the BAS will be sharing their time, equipment, and expertise with our class and the general public. We will be operating under Star Party and State Park regulations. It will run from roughly 5:30 PM to 10:00 PM. 15 points.

Possible Dates:

- January 11, 2020

- February 8, 2020
- March 14, 2020
- April 11, 2020

UTC Clarence T. Jones Observatory field trip. Bring the Jones Observatory Q&A Sheet from your lab manual. See UTC Jones Observatory Schedule. Usually it is Sunday Evenings starting January 26 and ending April 19--15 points

The University of Tennessee at Chattanooga

Introduction to Astronomy: Stars to Galaxies

Fall 2023

ASTR 1020, CRN 40163, Face-to-face, 3 credit hours

Instructor: Dr. Josh Hamblen

Email and Phone Number: Joshua-Hamblen@utc.edu, 423-425-5392

Office Hours and Location: Tue 11-12, Thu 11-12, Fri 11-12 Grote 205
(You're welcome to schedule an alternate meeting time with me as well.)

Course Meeting Days, Times, and Location: Tuesday, Thursday 1:40 – 2:55 pm, Grote 131

Course Catalog Description: Nature of stars and galaxies; evolution and structure of the observable universe with emphasis on the experimental foundations of the science. Fall semester.

Course Pre/Co Requisites: ASTR 1020L

Course Student Learning Outcomes: Welcome to **Introduction to Astronomy - Stars to Galaxies**! Our overall objective is to acquaint you with the history, theories, and current research in one of humankind's grandest adventures: the investigation of the physical structure, evolution, and origin of the universe. Although the course will focus primarily on stars and larger structures, we will find that astronomers must use knowledge from many other areas of science in their search for answers. In pursuing our quest, we will stress the physical principles which underlie our current theories, i.e., how do we know what we know? What are the uncertainties in our knowledge? Many of the laboratory activities are designed to explore these questions by introducing you to some basic laws of physics and their application to astronomy.

Specific student learning outcomes assessed in this course:

- Understand the scientific method and how it establishes the physics theories needed to study astronomy.
- Investigate the properties of electromagnetic radiation and how we detect it using telescopes.
- Determine the many properties of a star by detecting the light it emits.
- Explore the full life cycle of stars from their birth to their death.
- Explore how stars group together in galaxies.
- Determine the need for dark matter and how we establish its existence.
- Build a theory that accurately describes the beginning of the universe based on available experimental data.

General Education Student Learning Outcomes: ASTR 1020 and 1020L together fulfills the general education Natural Science Laboratory category. Upon completion of the required credit hours in this category, students will be able to:

- Students will explain how scientific knowledge develops over time as new evidence emerges.
- Students will demonstrate scientific literacy by locating, evaluating, interpreting, and applying scientific information/data.
- Students will explain how scientific developments impact society.
- Students will demonstrate the connection between scientific theory and application.
- Students will apply the methods of science by testing hypotheses and reporting the results.

Required Course Materials: Textbook: Astronomy by Fraknoi, Morrison, and Wolff, OpenStax publishing, 2018**. It is free to read and download at:** https://openstax.org/details/books/astronomy.

A **scientific calculator** is also required. You will be allowed to use one, so own one and bring it. You should familiarize yourself with how to use scientific notation and trigonometric functions on it.

Technology Requirements for Course: Access to the internet for UTC Learn announcements as well as the textbook on the OpenStax website, and a scientific calculator.

Technology/Digital Literacy Skills Required for Course: Students should be able to use email, UTC Learn, and their scientific calculator.

Course Assessments and Requirements: The grading weights will be as follows:

(a) 2 in-class exams (20% each)	= 40%
(b) Best 3 of 4 Quizzes	= 20
(c) Homework	= 20
(d) Final Exam	= 20
	100%

Course Grading

Course Grading Policy: There will be two scheduled hourly exams during the semester, 4 brief (15 min.) quizzes, and a final exam at our scheduled time at the end of the semester.

No extra credit work other than that provided on homework, quizzes, and exams may be done to substitute for low grades or missed homework, quizzes, or exams. No exceptions.

Homework Instructions: End of chapters exercises will be assigned from the textbook. Your answers must be in complete sentences, and if it a calculational problem, all your work must be shown. **Homework assignments and due dates will be announced on UTC Learn, and you will also submit your completed assignments to UTC Learn.**

If you need help in completing an assignment, I will be glad to help you after you have made a reasonable effort to work them on your own. Visit me during my office hours or contact me to make an appointment.

Instructor Grading and Feedback Response Time: A *tentative* guide for the overall course grade will be: A ≥ 90 > B ≥ 80 > C ≥ 70 > D ≥ 60 > F. **The total grade contribution for quizzes and homework will for each be a maximum of 100%** (e.g., working extra credit problems for homework will not be allowed to bring the homework part of the total grade to greater than 100%). Graded assignments typically will be returned within one week.

Course Policies

Late/Missing Work Policy: Please note that **it is the student's responsibility** to make up work as follows:

- Exams may only be retaken due to (a) illness, or (b) a family emergency (verification will be required—see below). Make-up exams must be scheduled within 3 days of the student's return to classes. Please note that my make-up exams are equal to or exceed the original exam in difficulty.
    - If you are unable to attend class and would like to request a make-up exam, you should complete the university's Academic Notification process as soon as possible.
- Homework must be submitted to UTC Learn by the assigned date. Assignments submitted after the due date will be counted as late and subjected to a 20% penalty. Assignments submitted more than one week after the original due date **will not be accepted**.
- Quizzes which are missed cannot be made up.

Course Attendance Policy: Attendance in lecture is **strongly encouraged**. Since the majority of material covered on exams will also be covered in class lectures and labs, those students who attend regularly and take good notes tend to have a definite advantage on exams. Those students having borderline grades at the end of the course **may** be helped toward the higher grade if they have maintained a very strong record of attendance ***and*** participation in the class.

Course Participation/Contribution: To be successful in this course, students are expected to read the textbook, complete homework assignments/quizzes/exams, attend class regularly, and ask and answer questions in class.

Course Calendar/Schedule: Here is schedule of lectures and test/quiz dates. **Students are expected to come to class with the assigned material read beforehand.**

Week of:	**Material Covered:**
Tue. 8/22 – Thu. 8/24	Intro to Class and Ch. 1 – Science and the Universe
Tue. 8/29 – Thu. 8/31	Ch. 2 – Observing the Sky, section 1 Begin Ch. 3 – Orbits and Gravity, selected sections
Tue. 9/5 – Thu. 9/7	Finish Ch. 3 Begin Ch. 5 – Radiation and Spectra **Quiz 1 on 9/7**
Tue. 9/12 – Thu. 9/14	Finish Ch. 5 Begin Ch. 6 – Astronomical Instruments
Tue. 9/19 – Thu. 9/21	Finish Ch. 6 **Exam 1 (Chs. 1, 2, 3, 5, 6) on 9/21**
Tue. 9/26 – Thu. 9/28	Ch. 16 – Nuclear Fusion and Stellar Interiors Ch. 17 – Analyzing Starlight
Tue. 10/3 – Thu. 10/5	Ch. 18 – The Stars: A Celestial Census Ch. 19 – Celestial Distances **Quiz 2 on 10/5**
Tue. 10/10 – Thu 10/12	Finish Ch. 19 Ch. 21 – The Birth of Stars and Search for Planets
Tue. 10/17	**No Class – Fall Break**
Thu. 10/19	Ch. 22 – Stars from Adolescence to Old Age
Tue. 10/24 – Thu. 10/26	Finish Ch. 22, Begin Ch. 23 – The Death of Stars **Quiz 3 on 10/24**
Tue. 10/31 – Thu. 11/2	Finish Ch. 23 **Exam 2 (Chs. 16, 17, 18, 19, 21, 22, 23) on 11/2**
Tue. 11/7 – Tue. 11/14	Ch. 24 – Black Holes
Thu. 11/16 – Tue. 11/21	Ch. 25 – The Milky Way
Thu. 11/23	**No Class – Thanksgiving**
Tue. 11/28 – Thu. 11/30	Ch. 26 – Galaxies **Quiz 4 on 11/28**
Thursday, December 7	**Final Exam 1:00 – 3:00 PM (Chs. 24-27) in Grote 131** **(Be available at this time; you will not be able to take it on a different day!)**

WHEN I heard the learn'd astronomer;
When the proofs, the figures, were ranged in columns before me;
When I was shown the charts and the diagrams, to add, divide, and measure them;
When I, sitting, heard the astronomer, where he lectured with much applause in the lecture-room,
How soon, unaccountable, I became tired and sick;
Till rising and gliding out, I wander'd off by myself,
In the mystical moist night-air, and from time to time,
Look'd up in perfect silence at the stars.
--Walt Whitman

Whitman, Walt. Leaves of Grass. Philadelphia: David McKay, [c1900]; Bartleby.com, 1999. www.bartleby.com/142/. [Date of Printout].

The University of Tennessee at Chattanooga

Astronomy Laboratory – Stars to Galaxies

Fall 2022

The Department of Chemistry and Physics

ASTR 1020L-2 CRN 40552 1 hr.
ASTR 1020L-3 CRN 45682 1 hr.
Face to Face Modality

Instructor: Mr. Steven Kline

Email: Steven-Kline@utc.edu (Best way to get me)

Office Hours and Location: Thursdays 10:00AM-12:00 PM (also by appointment) Library 335

Course Meeting Days, Time, and Location:

CRN 40552 Thursdays 3:00 PM-4:50 PM GROTE 217
CRN 45682 Thursdays 3:00 PM-4:50 PM GROTE 216

Course Catalog Description: Laboratory to accompany Astronomy 1020. Exercises include learning to set up and use a telescope, stellar spectroscopy, a deep sky observing session (if possible), a visit to *UTC* Jones Observatory and Planetarium, photometry, and the Hubble Redshift-Distance relation. Fall semester. *Two hours per week. Co-requisite: Astronomy 1020 or permission of the head of the department.*

Course Pre/Co Requisites: Co-requisite: Astronomy 1020 or permission of the head of the department.

Course Student Learning Outcomes: Upon completion of the required credit hours in ASTR 1020 and 1020L, students will be able to meet the following outcomes as they apply to introductory astronomy:

• Explain intellectual foundations, conceptual approaches, and methodologies of astronomy.

•Understand and explain scientific terminology.

• Discuss historical, social, and political issues related to scientific data and advances.

• Construct graphic and analytical models from a description of a specific natural phenomenon.

• Formulate a hypothesis based on empirical data.

• Apply the scientific method to solve problems.

• Design experiments to test hypotheses.

• Express conclusions and implications from scientific experiments using a variety of methods.

• Experience the methods and technology of scientific inquiry.

• Demonstrate significant concepts of the discipline.

• Use scientific technology to gather and interpret data.

•Practice the development of independent thought.

General Education Statement: Astronomy 1020 and 1020L together fulfill 4 credit hours of the general education requirement in Natural Science Laboratory (SL) courses**.**

Course Fees: Lab fees will be assessed.

Required Course Materials/Resources: UTC Astronomy 1020L Laboratory Manual. Weekly experiments are downloadable from the course website on UTCLearn. Also, a simple scientific calculator must be brought to each lab period. **Required.**

Technology Requirements for Course: Simple Scientific Calculator

Technology Skills Required for Course: It will be helpful if you are comfortable with general computerized operations in a Windows 10 environment. It will also be helpful if you are proficient with spreadsheet software such as Excel. If you have not yet mastered Excel, you will be given plenty of help, encouragement, and opportunities to practice.

Technology Support: If you have problems with your UTC email account or with UTC Learn (Canvas), contact IT Help Desk at 423-425-4000 or email helpdesk@utc.edu.

Student Technology: If you have technology needs to access your courses and/or complete course requirements in Canvas, submit a request with Information Technology.

Course Assessments and Requirements: The weighting of the overall course grade is tentatively set forth below; students will be notified in class if a reassignment of weights becomes necessary. Points will be based on a combination of Lab Experiments and Field Trips.

160	Maximum Possible
135-150	A
120-134	B
105-119	C
90-104	D
0-89 Points	F

Instructor Grading and Feedback Response Time: Every effort will be made to provide timely feedback. Usually, lab reports will be graded in time to be returned at the next class meeting. Results are usually posted to CANVAS before the next class meeting.

Policy for Late/Missing Work: *Missed labs* must be rescheduled at the convenience of the instructor and any lab partners who may be necessary. If you must miss a lab session, that session should be made up as soon as possible. *Late lab reports* **will not be accepted without the instructor's prior permission and** will result in a grade of zero for that lab.

Student Conduct Policy: UTC's Student Code of Conduct and Honor Code (Academic Integrity Policy) can be found on the Student Conduct Policy page.

Honor Code Pledge: I pledge that I will neither give nor receive unauthorized aid on any test or assignment. I understand that plagiarism constitutes a serious instance of unauthorized aid. I further pledge that I exert every effort to ensure that the Honor Code is upheld by others and that I will actively support the establishment and continuance of a campus-wide climate of honor and integrity.

Attendance Policy: Attendance in all Astr1020L lab sessions is ***mandatory***. Attendance will be recorded for all lab sessions, except for those students engaged in special studies as determined by the instructor. **Absence from more than 3 regularly scheduled laboratory sessions -- without prior permission from the lab instructor --will result in an F for the lab grade.**

Student Accommodations: If you have accessibility and accommodation requests, contact the Disability Resource Center at 423-425-4006 or email DRC@utc.edu.

Student Support Resources and Privacy and Accessibility Statements: A list of student resources and privacy and accessibility statements are available on the WCTL Student Resources Page.

Course Learning Evaluation: Course evaluations are an important part of our efforts to continuously improve the learning experience at UTC. Toward the end of the semester, you will receive a link to evaluations and are expected to complete them. We value your feedback and appreciate you taking time to complete the anonymous evaluations.

COURSE CALENDAR AND SCHEDULE

Date	Title	Points
8/24	First Week – No Lab	
8/31	Introduction to Lab and Clear Dark Sky Weather Forecast	10
9/07	Hallo Northern Sky	10
9/14	Telescope Lab-Polar Alignment, Altitude Azimuth, etc.	10
9/21	Astro-Imaging Lab	10
9/28	Spectroscopy of Light	10
10/05	Stellar Spectroscopy (CLEA) Introduction to CLEA labs	15
10/12	Photoelectric Photometry of the Pleiades (CLEA) Week One	
10/19	Photoelectric Photometry of the Pleiades (CLEA) Week Two	15
10/26	Hubble Redshift Distance Relation (CLEA) Week One	
11/02	Hubble Redshift Distance Relation (CLEA) Week Two	15
11/09	Radio Astronomy of Pulsars (CLEA)	15
11/16	Hertzberg-Russell Diagram (NAAP)	15
11/23	Thanksgiving Break	
11/30	Miscellaneous Day	
12/04	Last Day – Everything Due	

Out of Class Assignments

There is one assignment that takes place outside of standard lab hours and is not included in the schedule above. It is the module named Observatory Visit. A schedule for the operating hours of the observatory will be posted when finalized and will be available on UTC's website. In the event you are unable to attend any of the scheduled nights, an alternative assignment is included in the module.

The University of Tennessee at Chattanooga

Science and Society

Spring 2023

General Science 1150 (CRN# 20658), Online, 3 credit hours

Instructor: Dr. David Welch

Phone and Email: (423) 425-4278; hps296@tennessee.edu

Office Hours and Location: on Zoom by appointment

Course Meeting Days, Time, and Location: This is an online class with materials available through UTC Learn. You will log in to the system several times each week to access materials and submit assignments. You can also reach the instructor through this web interface.

Course Catalog Description: *Explores the interrelationship of science and society through discussion of scientific issues that are vitally important to our society and everyday life. Specific topics may vary in keeping with current issues but are likely to include the technology revolution, the energy crisis and possible solutions, the importance of science to our economy and defense, the impact of politics and the economy on scientific research, and space science. On demand.*

Course Student Learning Outcomes: This course is a survey of the basic physical principles guiding energy and its uses in society. The main fields and scientific principles we will base our discussion on come from the fields of physics and chemistry, including mechanical work and power, thermodynamics, and the atomic structure of matter. We will review these principles and see how they are adapted to our modern ideas of energy usage in contemporary society. Discussion will include the ideas of efficiency and conservation. We will explore different sources of energy, such as fossil fuels and alternative sources. We will also address the impact of science on society, including human health. Through directed discussions and assignments, students will gain confidence in writing and speaking about these topics. Most importantly, we hope that this course introduces and provides a sound foundation for further exploration into the relationship between science and society, educated discovery and the planning of human impact on the physical environment, and informed discussion in public debate.

Course Pre/Corequisites: n/a

Communication: The primary channels of communication are UTC Learn and email. Announcements will be made through these channels. Please check them regularly. If you have problems setting up or accessing your account, please contact the Solutions Center at 423-425-4000.

General Education Statement: This course is a General Education Natural Sciences course (non-laboratory). Upon completion of the required credit hours in this category, students will be able to:

1. Students will explain how scientific knowledge develops over time as new evidence emerges.
2. Students will demonstrate scientific literacy by locating, evaluating, interpreting, and applying scientific information/data.
3. Students will explain how scientific developments impact society.

Course Materials/Resources: Required Textbook – Energy: Its Use and the Environment by Hinrichs and Kleinbach, 5th ed. (Cengage);

In addition to the textbook, we will make use of resources accessible from UTC Learn (Canvas), as well as hyperlinked documents from the internet. A calculator is required for some of the assignments.

Online material will be organized by week. Each week will have its own folder within which you will find links to the readings, additional information from the instructor (e.g., presentations, videos, instructor notes), and weekly assignments.

Technology and Technology Skills Required: This course requires reliable internet access. You should have operational knowledge of a web browser (e.g., visiting links and downloading files), word processor (e.g., MS-Word), and presentation software (e.g., MS-PowerPoint). Visit this link to test your computer's compatibility with UTC Learn: http://www.utc.edu/learn/getting-help/system-requirements.php

Course Assessments and Requirements: (due dates are in the course calendar).

Grading Scale:

• Tests (5@60 pts.)	300 points
• Sample problems (5@20 pts.)	100 points
• Projects (1@50 pts; 2@100 pts)	250 points
• Discussion boards (10@35 pts)	350 points
Total:	**1000 points**

Grading Scale: 90–100% = A; 80–89% = B; 70–79% = C, 60–69% = D; <60% = F

Policy for Late/Missing Work: Late work will not be accepted without proof of illness or family death.

Attendance Policy: You will be required to participate in the course every week more than once. Failing to promptly complete the readings and assignments can only hurt your performance.

Course Assignments: *Tests* are made up of multiple-choice questions that randomly vary for each student. They are to be completed individually. Tests are timed and each question can be encountered only once (i.e., you cannot go back to a question). The tests are 45 minutes long.

Discussion boards will allow you to respond to the text and engage with other students. They are graded according to the rubric posted on UTC Learn. The instructor will post questions that you must respond to by Wednesday of each week. You should respond to at least two of you peers' responses by Saturday. Proper 'netiquette' is essential and will be included as a factor in the evaluation. More detail on the requirements for successfully completing this component of the course is on UTC Learn.

Sample calculations are short, quantitative questions dealing with concepts from the textbook.

Projects are more in-depth explorations of how course concepts may impact your life. More information will be given on how to complete each one. They are to be completed individually and will be submitted through SafeAssign, a plagiarism-detection tool.

Course Deadlines: Assignments are due by the end of the day listed. For example, an assignment due by "Wednesday" is due by Wednesday, 11:59 P.M.

Course Calendar/Schedule:

- Week 1 = January 10–16, Math Review; Introduction to Energy
  1) Study syllabus, Chapter 1 of the textbook, and "Week 1" online materials.
  2) Take the syllabus quiz ("Extra Credit #1") to ensure that you're ready **(20 pts)**.
  3) Complete the diagnostic quiz ("Sample Problems #1") by Wednesday.
  4) Post a response to readings by Wednesday ("Discussion Board #1").
  5) Response posts are due by Saturday.

- Week 2 = January 17–23, Concepts of Mechanics; Conservation of Energy
  1) Complete the problem set ("Sample Problems #2") by Saturday.
  2) Study Chapter 2 of the textbook and "Week 2" online materials.
  3) Post in "Discussion Board #2" by Wednesday.
  4) Response posts are due by Saturday.

- Week 3 = January 24–30, Conservation of Energy
  1) Complete the problem set ("Sample Problems #3") by Wednesday.
  2) Study Chapter 3 (pages 83–88), Chapter 4 of the textbook and "Week 3" online materials.
  3) Take **Test #1** by Sunday.

- Week 4 = January 31–February 6, Thermodynamics
  1) Complete the problem set ("Sample Problems #4") by Wednesday.
  2) Study Chapter 5 and "Week 4" online materials.
  3) Submit "Project #1" by Sunday.

- Week 5 = February 7–13, Electricity Generation;
  1) Study Chapter 11 and "Week 5" online materials.
  2) Complete the problem set ("Sample Problems #5") by Wednesday.
  3) Post in "Discussion Board #3" by Wednesday.
  4) Response posts are due by Saturday.
  5) Take **Test #2** by Sunday.

- Week 6 = February 14–20, Sources of Energy
  1) Read Chapter 7, Chapter 8 (374–387), and "Week 6" online materials.
  2) Post in "Discussion Board #4" by Wednesday.
  3) Response posts are due by Saturday.
  4) Submit a topic for Project #2 by Sunday for instructor approval (**10 pts**).

- Week 7 = February 21–27, Environmental Impacts from Human Activity
  1) Study Chapter 8 (pages 233–244), Chapter 9 (pages 275–294), and "Week 7" online resources.
  2) Submit Project #2 by Sunday.

- Week 8 = February 28–March 6, Philosophy of Science
  1) Study "Week 8" online resources.
  2) Post in "Discussion Board #5" by Wednesday.
  3) Response posts are due by Saturday.

- Week 9 = March 7–13, Economic Impacts of Scientific Advances
  1) Study "Week 9" online resources.
  2) Post in "Discussion Board #6" by Wednesday.
  3) Response posts are due by Saturday.
  4) Take **Test #3** by Sunday.

- Week 10 = March 14–20, Spring Break, No Class

- Week 11 = March 21–27, Novel Risks arising with Scientific Advances
  1) Study "Week 10" online resources.

2) Post in "Discussion Board #7" by Wednesday.
3) Response posts are due by Saturday.

- Week 12 = March 28–April 3, Nuclear Power (and Weapons, Too)
  1) Study Chapters 13 and 14 and "Week 12" online resources.
  2) Submit a topic for Project #3 by Sunday for instructor approval (**10 pts**).
  3) Take **Test #4** by Tuesday, 4/5.

- Week 13 = April 4–10, Other Alternatives to Fossil Fuels
  1) Study Chapter 16, Chapter 18, and "Week 13" online resources.
  2) Post in "Discussion Board #8" by Wednesday.
  3) Response posts are due by Saturday.

- Week 14 = April 11–17, Science and Human Health, Pt. 1
  1) Study "Week 14" online resources.
  2) Post in "Discussion Board #9" by Wednesday.
  3) Response posts are due by Saturday.
  4) Submit Project #3 by Sunday.

- Week 15 = April 18–24, Science and Human Health, Pt. 2
  1) Study "Week 15" online resources.
  2) Post in "Discussion Board #10" by Wednesday.
  3) Response posts are due by Saturday.
  4) Take **Test #5** by Monday, 4/25.

Phys 1030 General Physics: Mechanics and Heat

Term:	Fall 2022
CRN:	40147
Credits	3 credit hours
Location:	Virtual Classroom: UTC Learn (Canvas) and zoom
Faculty	Dr. Tatiana Allen, (Tatiana-Allen@utc.edu)
Dates/Time	Weekly live zoom meetings: Tuesday, Thursday 9:25-10:40 am, https://tennessee.zoom.us/j/304118539
	Student Drop-In Hours: Tuesday and Thursday 12:15-1:00 pm in the zoom classroom https://tennessee.zoom.us/j/91694059722. If you cannot make it to my regularly scheduled drop-in hours, email me to set up a different time that works for both of us. Also, regularly check Canvas for any additional help opportunities.

Course Catalog Description: 1030 General Physics – Mechanics and Heat (3 credit hours)
Algebra-based introduction to forces and uniform motion, conservation principles, sound and thermodynamics, with applications to problems of modern science and technology. Lecture 3 hours.
Prerequisites: *MATH 1720, or MATH 1730, or MATH 1830, or MATH 1950, or department head approval.*
Corequisites: *PHYS 1030L laboratory, or department head approval.*

Course Learning Outcomes (CLO):

CLO#1	Demonstrate conceptual understanding of physics principles and how they fit together to provide a coherent description of physical phenomena.
CLO#2	Demonstrate knowledge of physics vocabulary, including definitions of physical quantities and their units.
CLO#3	Demonstrate understanding of the relations between physical quantities (equations).
CLO#4	Develop problem solving skills: the ability to reason physics problems in an organized and mathematically correct manner.
CLO#5	Describe applications of physics principles to day-to-day living and development of technology.

General Education Statement: This course fulfills a general education requirement of the university in the Natural Science Laboratory (SL) category *only* when taken in combination with Physics 1030 laboratory.

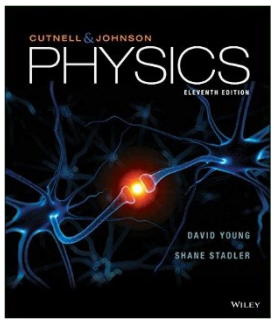
General Education Outcomes: General education outcomes can be found at http://www.utc.edu/general-education/faculty-information/outcomes.php and are as follows:

Upon completion of the required credit hours in this category, students will be able to:

- Explain intellectual foundations, conceptual approaches, and methodologies of the natural sciences.
- Understand and explain scientific terminology.
- Discuss historical, social and political issues related to scientific data and advances.
- Construct graphic and analytical models from a description of a specific natural phenomenon.
- Formulate a hypothesis based on empirical data.

- Apply the scientific method to solve problems.
- Design experiments to test hypotheses.
- Express conclusions and implications from scientific experiments using a variety of methods.

Required Course Materials:



- **Textbook** for this class is Physics vol.1, 11th ed., by John D. Cutnell and Kenneth W. Johnson, Hoboken, New Jersey, John Wiley & Sons, Inc., c. 2018. ISBN is 9781119497004. We shall concentrate on selected topics in Chapters 1-17.
- **Access to the WileyPLUS**, which is the web site to accompany the book. We will be using **New Wiley PLUS a.k.a. NEXT GEN**. WileyPlus is often included in the cost of a new text (check with the Bookstore to be sure) or can be purchased instantly on-line https://www.wileyplus.com/student-register/. Check the price so you can budget for it. There is a two weeks grace period during which you can access the website for free. Once purchased, your access to WileyPlus runs for three consecutive semesters (13 months). **The website for self-registration will be announced through UTC Learn (CANVAS) – see the student flyer.**

Supplemental/Optional Course Materials:
With Wiley Plus, you will get access to electronic version of the book. **I strongly recommend getting a printed version of the book**, even if it is an earlier edition (anything from 7th edition and up will do). You can find earlier editions at used books stores or online for a very reasonable price. If you cannot find Cutnell and Johnson's printed book, any "College Physics" book (algebra and trigonometry-based course) is better than nothing. Do not get "University Physics", because it is a calculus-based course. The Student Study Guide and Student Solutions Manual are also available and recommended as a useful aid in problem solving.

Technology Requirements for Course:
- Access to a computer with a reliable internet connection and a Web Browser.
- Web camera.

Technology Skills Required for Course: You are expected to have a working knowledge of using email, UTC Learn (CANVAS), web applications, YouTube, internet search engines, Microsoft Word, Microsoft PowerPoint, and Adobe Acrobat to complete course requirements.

Communication:
All items in this syllabus are tentative. Class announcements will be made through UTC Learn (CANVAS). Please enable automatic notifications of CANVAS announcements. Check your UTC email and UTC Learn (CANVAS) on a regular basis. **It is the responsibility of the student to keep informed of any changes made in assignments, exam and/or homework due dates, or changes in the course format itself, new materials, missed content. Students are also responsible for all information given in the course.**
Email is **the best way** to contact me. Inquiries will be replied to as soon as possible, usually within 24-48 hours on workdays. **Please note** that if several students email with the same question, I usually reply by **posting an announcement** through UTC Learn instead of answering individually. Sometimes, although extremely rarely, my e-mail client puts incoming emails into TRASH folder, so I do not see them. If I have not replied to your email in 3 (three) business days, this might be the case. Please email again.

Preferred Names: If your preferred name is not the same as the name that appears on the university provided roster for the course, please let me know so that I can use your preferred name. Please use your official or preferred name when login to zoom, so I can identify you.

Course Structure:
The course is organized by chapter. For each chapter you will be given multiple opportunities to practice the concepts and skills (and make mistakes, which is a normal part of leaning process). In addition to the zoom sessions, you will be using Wiley Plus Portal that provides a multitude of resources and practice opportunities that you need to complete to be successful in this course. Every week you will find reading assignments, video assignments, practice problems, homework, exam review posted on Wiley Plus. The deadline for each assignment will be posted on Wiley Plus; the grades for each assignment will be kept in Wiley Plus Grade Book. I will consolidate Wiley Plus grades and post them on Canvas at Midterm, and then again at the end of the semester. I provide multiple opportunities for students to receive feedback on their performance throughout the course to give students ways to see how they are doing and so that they can identify places they need to apply more effort or new strategies along the way, seek help if they are struggling and improve throughout the semester. My hope is that all students will develop the knowledge they need to do well in this course and that all students--even those who perform well early in the semester—will develop greater knowledge and skills through practice and exams.

Course Participation/ Engagement/Contribution: This is an online class, and it is very important that you attend the live zoom sessions and stay engaged during the whole semester. This is a three credits course, so you should expect to spend 6-9 hours per week on this course in addition to zoom sessions. You are expected to complete all scheduled activities to get the maximum credit.

Exams will be administered through Canvas. Exam grades (but not the grades for other assignments) will be normalized ***if necessary***.

Course Deadlines: Each assignment will have a posted deadline. *It is your responsibility to plan ahead so that your work is turned in on time.* Work that is submitted online will receive credit only if submitted **on time**: this means that your work should be submitted prior to the posted date and **time**. Information submitted **after** the posted time will be refused by the server, even if the time at which you logged onto the server was prior to the deadline.

Late/Make-Up Work Policy:

- Life happens; therefore, I drop the lowest grade in each category of assignments (1 semester exam, 1 assignment of each type on Wiley Plus), no questions asked.
- If you experience a life situation such as a serious illness or family emergency that makes it difficult for you to meet the deadlines, please email me **before the deadline,** if you can. You also should contact the Student Outreach and Support (SOS) services and complete the Academic Notification process as soon as possible. The SOS office will review your documentation and may request accommodations based on your situation. As soon as I receive the letter from the SOS office, I will work with you on the deadlines.
- All make up work should be completed within one week of your return to school, but no later than Friday, December 2nd.
- **No extra credit work may be done to substitute for low grades or missed assignments.**

Grading Policy: a **tentative** grading plan will be as follows:

Wiley Plus Weekly (one assignment in each category will be dropped):	16%
Exams, (4, drop 1) @ 18% each:	54%
Final exam (comprehensive):	30%
Total	**100%**

Grading Scale and Feedback Response Time:

Final Grade	Percentages	Definitions
A	**90%-100%**	**"A"** represents an evaluation of work which **exceeds** competency standards, depicts mastery, and demonstrates an exceptional understanding of the subject matter.
B	**80%-89%**	**"B"** represents an evaluation of work which **meets** competency standards for thoroughness and depicts a thorough understanding of the subject matter.
C	**70%-79%**	**"C"** represents an evaluation of work that is **satisfactory** relative to standards of competency but lacks some areas of thorough understanding of the deliverables and the subject matter.
D	**60%-69%**	**"D"** represents marginal performance below the acceptable standards of university work.
F	**<60%**	**"F"** indicates unqualified failure and the necessity for repeating the course to obtain credit.

Final grades will be rounded precisely. If you have an 89.4% final average, this is a B. If you have a 69.5%, this is a C. UTC does not use +/- grades.

Instructor Grading and Feedback Response Time: The grades for practice assignments will be available on Wiley Plus immediately after final submission. The grades for exams will be posted on the UTC Learn as soon as the exam is graded (usually within 14 days). Please check the online grade book ("My Grades" on Canvas) for each exam. **If you notice an error with a grade, please contact me within one week of the grade being posted** to clear up the problem.

Please read and study the **CAMPUS SYLLABUS** that provide you with important information related to all UTC classes such as academic integrity, student conduct and pledges, academic support resources, student health and wellness, UTC-alert system, covid-19-related information and policies, etc.
A copy of the Campus Syllabus is available in the same folder on Canvas.

Schedule (tentative, the dates can change; the announcements will be through UTC Learn/ CANVAS)

Week	Dates	Material/ Assessment
1	8/22 – 8/28	Ch 1: Introduction and Mathematical Concepts: Units, Trigonometry and Vectors
2	8/29 – 9/04	Ch 2: Kinematics in One Dimension
3	9/05 – 9/11	Ch 3: Kinematics in Two Dimensions
4	9/12 – 9/18	Ch 3: Kinematics in Two Dimensions, cont. **Exam 1 (Chs. 1-3) = Thursday, 9/15**
5	9/19 – 9/25	Ch 4: Forces and Newton's Laws of Motion
6	9/26 – 10/02	Ch 5: Dynamics of Uniform Circular Motion, Ch 6: Work and Energy
7	10/03 – 10/09	Ch 6: Work and Energy, cont. Ch 7: Impulse and Momentum
8	10/10 – 10/16	**Exam 2 (Chs. 4-6) = Tuesday, 10/11** Ch 7: Impulse and Momentum, cont.
	10/17 – 10/18	**Fall break**
9	10/19-10/23	Ch 8: Rotational Kinematics
10	10/24 – 10/30	Ch 9: Rotational Dynamics
11	10/31 – 11/6	Ch 10: Simple Harmonic Motion and Elasticity
12	11/7 – 11/13	**Exam 3 (Chs. 7 - 10) = Tuesday, 11/8** Ch 12: Temperature and Heat
13	11/14 – 11/20	Ch 14 Ideal Gas Law and Kinetic Theory, cont.
	11/21 – 11/27	Ch 15: Thermodynamics **(11/23-11/27 = Thanksgiving Holiday)**
14	11/28 – 12/4	Ch 15: Thermodynamics, cont. **Exam 4 (Chs. 12, 14, 15) = Thursday, 12/1**
		Final exam (comprehensive) – Thursday, December 8th, 8-10 a.m. https://www.utc.edu/enrollment-management-and-student-affairs/registrar/calendars-and-schedules/fall-2022

The University of Tennessee at Chattanooga

General Physics Laboratory – Mechanics and Heat

Fall 2022

Physics, 1030L,40150-40151, face to face, 1 credit hours

Instructor: Dr. Luis E. Sanchez-Diaz

Email and Phone Number: luis-sanchezdiaz@utc.edu, (423) 425-4546 and Zoom Meeting ID

Luis Sanchez is inviting you to a scheduled Zoom meeting.

Meeting ID: 958 619 9280

Passcode: Sc25R4

Office Hours and Location: : Monday 12:00 PM to 1:00 PM, and Tuesday 11:00 AM to 1:40 PM in Grote Hall room 203. If you cannot attend my office hours, please email me with your questions any time; I will respond within 24 hours. Zooms appointments are available as needed.

Course Meeting Days, Times, and Location: Click here to enter text.

CRN 40150 : Monday. 10:00PM – 11:50 PM, GROTE 216
CRN 40151: Monday. 10:00PM – 11:50 PM, GROTE 217

Course Catalog Description: Laboratory to accompany Physics 1030. Experiments investigate various aspects of forces and uniform motion, conservation, principles, sound, and thermodynamics.

Course Pre/Co Requisites: *Corequisite*: Physics 1030 or permission of the head of the department

Course Student Learning Outcomes: This course provides you with "hands on" experience with some of the laws and methods of analysis that you learn in PHYS1030 lecture. These are the laws that physicists have used in order to understand the world around us. Many of the lab exercises are computer-assisted, meaning that computers will be used in the taking and/or analysis of experimental data. Upon completion of this course, student will be able to:

1. Build intellectual foundations, conceptual approaches, and methodologies of the natural sciences.
2. Construct graphic and analytical models from a description of a specific natural phenomenon.
3. Formulate a hypothesis based on empirical data.
4. Apply the scientific method to solve problems.

5. Design experiments to test hypotheses.
6. Express conclusions and implications from scientific experiments using a variety of methods

General Education Statement: This course fulfills a general education requirement of the university in the Natural Science Laboratory (SL) category *only* when taken in combination with Physics 1030.

- Students will explain how scientific knowledge develops over time as new evidence emerges.
- Students will demonstrate scientific literacy by locating, evaluating, interpreting, and applying scientific information/data.
- Students will explain how scientific developments impact society.
- Students will demonstrate the connection between scientific theory and application.
- Students will apply the methods of science by testing hypotheses and reporting the results.

Required Course Materials: Click here to enter text.

Laboratory Manual: A description of all experiments are available online at UTC Learn. The schedule shows which experiment you should perform for in any given week.

***Scientific* Calculator**: You will be expected to use one. It need not be a graphing calculator but should be able to perform calculations like taking the logarithm of a number, exponents, and trigonometric functions. It should also be capable of handling scientific notation (which will be explained in class).

Technology Requirements for Course: You need access to a computer with a reliable internet connection to complete this course. Test your computer set up and browser for compatibility with UTC Learn at http://www.utc.edu/learn/getting-help/system-requirements.php. As there are videos with sound that you must watch, you will also need speakers or headphones. You should also have an updated version of Adobe Acrobat Reader, available free from https://get.adobe.com/reader/.

Technology Skills Required for Course: These include using Microsoft Word and Excel, using the learning management system (UTC Learn), using MOCSNet email, creating and submitting files to UTC Learn, copying and pasting, and downloading and installing software. As there are videos with sound that you must watch, you will also need speakers or headphones.

Technology Support: If you have problems with your UTC email account or with UTC Learn (Canvas), contact IT Help Desk at 423-425-4000 or email helpdesk@utc.edu.

Student Technology: If you have technology needs to access your courses and/or complete course requirements in Canvas, submit a request (https://new.utc.edu/information-technology/learning-from-home) with Information Technology.

Student Accommodations: If you have accessibility and accommodation requests, contact the Disability Resource Center (https://www.utc.edu/disability-resource-center/index.php) at 423-425-4006 or email DRC@utc.edu

Course Assessments and Requirements:

There are eleven experiments and a final exam. Your lowest lab grade will be dropped. Several factors will be considered when grading each lab: (1) your ability and willingness to follow directions and diligently conduct the experiment and process data, (2) the results you obtain, which need not be perfect but should be "reasonable," (3) your answers to exercises and questions posed within each procedure, (4) and the quality of your writing when required by the procedure.

The lab reports will be graded, and the grades posted on UTC Learn as soon as possible, usually within one or two weeks of the due date. Grade-related questions will be accepted within one (1) week of the grade posting only in person (not by e-mail).

Grades are intended to reflect your level of educational achievement and motivate you to greater effort. An "A" represents superior performance, "B" commendable performance, "C" acceptable performance, and "D" marginal performance. "F" indicates failure and the need to repeat the course to obtain credit. The numeric breakdown of those letter grades is as follows:

A ≥ 90.0% B = 80-89.9% C = 70-79.9%; D = 60.0-69.9%; F < 60.0%
(NOTE: UTC does not use +/- grades)

Final Exam: The multiple-choice final exam will cover material from all labs done during the course. A fair amount of study is likely to be required to earn a good grade on this exam.

Course Grading: The tentative grading weights will be as follows:

Lab reports (best 10 of 11)	75%
Final test	25%
Total	100%

Course Grading Policy: 90-100% = A; 80-89% = B; 70-79% = C, 60-69% = D; <60% = F. Final grades will be rounded precisely. If you have an 89.4% final average, this is a B. If you have a 69.5%, this is a C.

Instructor Grading and Feedback Response Time: I will try my best to grade all assignments within one week of the due date and provide written feedback when necessary.

Course and Institutional Policies

Late/Missing Work Policy: Complete lab report that includes your data, calculations/graphs, results, conclusions. Late lab reports will not be accepted unless special arrangements are made with your instructor. Keep your graded reports for use when studying for the final exam.

Problems Encountered During an Experiment: The instructor and laboratory assistant are always available to help you, so don't hesitate to ask them—especially if your experimental results don't seem to make sense. You don't want to submit a lab report containing bogus data or results that defy well-established scientific principles, because chances are good that Newton was right, you are wrong, and your grade will suffer.

Lab Report Due Dates: The hand-written pre-lab portion of each lab report (including objective, relevant background, and methods) is due at the beginning of the session in which the experiment will be performed. Complete lab report that includes your data, calculations/graphs, results, conclusions, and any additional questions should be turned in to the instructor at the end of the lab session for most of the labs. In some cases, it should be submitted at the start of the following lab session. You will be told when each lab's work is due.

Electronic (e-mailed) lab reports will not be accepted. Late lab reports will not be accepted unless special arrangements are made with your instructor. Keep your graded reports for use when studying for the final exam.

Student Conduct Policy: UTC's Student Code of Conduct and Honor Code (Academic Integrity Policy) can be found on the Student Conduct Policy page (https://www.utc.edu/student-conduct/codes.php).

Honor Code Pledge: As a student of the University of Tennessee at Chattanooga, I pledge that I will not give or receive any unauthorized assistance with academic work or engage in any academic dishonesty in order to gain an academic advantage. I will exert every effort to ensure that the Honor Code is upheld by myself and others, affirming my commitment to a campus-wide climate of honesty and integrity

Course Attendance Policy:

Attendance is Required. If you miss a session, you'll receive a zero for that lab. Your instructor may allow a make-up session if you were ill or had a major emergency. Verification documents must be provided. The make-up form is available for download from CANVAS. The instructor's signature on that form is required to schedule a make-up session.

Promptness is Appreciated. Each lab begins with instructions and remarks by the instructor. If you miss those remarks, your ability (and your lab partners' ability) to perform

the lab may be affected. Therefore, **if you are late to a lab session** for more than 5 minutes, **you are not allowed to perform the experiment** and you will get zero for this lab, unless other arrangements has been made.

Course Participation/Contribution: The course contains several learning objectives that are critical to building a foundation in science. For this reason, several methods will be employed, including (but not limited to): lecture, group work, pre-class videos, and post-class work. To be successful in this course, I recommend that you engage in all methods.

Course Learning Evaluation: Course evaluations are an important part of our efforts to continuously improve the learning experience at UTC. Toward the end of the semester, you will receive a link to evaluations and are expected to complete them. We value your feedback and appreciate you taking time to complete the anonymous evaluations.

UTC Bookstore: The UTC Bookstore will price match Amazon and BN.com prices of the exact textbook - same edition, ISBN, new to new format, used to used format, and used rental to used rental format, with the same rental term. For more information, go to the Bookstore Price Match Program webpage, visit the bookstore, email sm430@bncollege.com or call 423-425-2184

Tentative Schedule*:

PHYS-1030 LAB SCHEDULE – Fall 2022- All sections

Grote 216 **Grote 217**

Session	Day	Date	Experiment
	M	08/22	No classes
1	M	08/29	Processing Experimental Data – Part 1
2	M	09/05	No classes
	M	09/12	Processing Experimental Data – Part 2
3	M	09/19	Acceleration of Gravity
4	M	09/26	Projectile Motion

5	M 10/03	Resolution of Forces
6	M 10/10	Friction and the Inclined Plane
	M 10/17	Fall Break
7	M 10/24	Conservation of momentum
8	M 10/31	Simple Pendulum
9	M 11/07	Spring Constant
10	M 11/14	Specific Heat Measurement
11	M 11/21	Standing Waves on a String
	M 11/28	No classes
	M 12/05	**Final Exam**

* This schedule, the grading scale, class policies, and everything on this syllabus, are subject to changes at the discretion of the instructor. It is the responsibility of the student to keep up with changes announced in class or on UTCLearn.

The University of Tennessee at Chattanooga

General Physics: Electromagnetism and Optics

Fall 2022

PHYS 1040, CRN 40148, Face-to-Face, 3 credit hours

Instructor: Dr. Josh Hamblen

Email and Phone Number: Joshua-Hamblen@utc.edu, (423)425-5392

Office Hours and Location: Tue 11-12, Thu 11-12, Fri 11-12 Grote 205
(You're welcome to schedule an alternate meeting time with me as well.)

Course Meeting Days, Times, and Location: Tue. Thu. 9:25 AM-10:40 AM, GROTE 317

Course Catalog Description: Algebra-based introduction to classical electricity and magnetism, optics, and the concepts of modern physics. Lecture 3 hours.

Course Pre/Co Requisites: Prerequisite: PHYS 1030 and PHYS 1030L, or department head approval. Corequisite: PHYS 1040L, or Prerequisite: PHYS 1040L, or department head approval.

Course Student Learning Outcomes: Welcome to the second part of General Physics! The objectives of this course are to help you develop a conceptual understanding, basic vocabulary, and problem-solving skills appropriate for an introduction to electricity and magnetism, optics, and modern physics. We shall focus on both basic science and its applications while discussing different empirical methods used to solve problems and make discoveries. These topics are, in a very large sense, responsible for the bulk of our 20^{th} and 21^{st} century technology, and we will discuss how they were historically developed. The laboratory gives hands-on experience with technologies and techniques used to measure physical quantities as well as practice using the scientific method of inquiry.

General Education Student Learning Outcomes: PHYS 1040 and 1040L together fulfill 4 credit hours of the general education requirement in Natural Science Laboratory (SL) courses. The overall outcomes for the category are:

- Explain intellectual foundations, conceptual approaches, and methodologies of the natural sciences.
- Understand and explain scientific terminology.
- Discuss historical, social and political issues related to scientific data and advances.
- Construct graphic and analytical models from a description of a specific natural phenomenon.
- Formulate a hypothesis based on empirical data.
- Apply the scientific method to solve problems.

- Design experiments to test hypotheses.
- Express conclusions and implications from scientific experiments using a variety of methods.

Required Course Materials: Our text will be Physics, 11th ed., by John D. Cutnell and Kenneth W. Johnson, Hoboken, New Jersey, John Wiley & Sons, Inc., c. 2015. We shall concentrate on selected topics in Chapters 18-32. **Students must have access to their own WileyPlus homework server account** for their homework. WileyPlus is typically included in the cost of a new text, or can be purchased online (https://wileyplus.com/). An online e-book, with all the features of the hard copy, is included in your WileyPlus account. For self-registration, go to www.wileyplus.com/go/login and enter our class code **B80519**. (**This is most likely similar to the textbook requirement you had for PHYS 1030.)**

In addition, you must have a **scientific calculator**. Bring it to **all** quiz and exam days. You will need it!

Technology Requirements for Course: You need access to a computer with a reliable internet connection to complete this course, and know how to use your scientific calculator.

Technology Skills Required for Course: These include using the learning management system (UTC Learn), using your UTC email account, and using a scientific calculator.

Course Assessments and Requirements: the tentative grading plan will be as follows:

(a) Exams 2@20% each	=	40%
(b) Best 3 of 4 Quizzes	=	20
(c) Homework (problems)	=	20
(d) Final Exam	=	20
		100%

Course Grading

Course Grading Policy: There will be two scheduled hourly exams during the semester, and 4 brief (15 min.) quizzes. Exams will consist primarily of problems similar to the homework; there will also be questions on the history of the discipline and/or its societal impact.

No extra credit work other than that provided on homework, quizzes, and exams may be done to substitute for low grades or missed homework, quizzes, or exams. No exceptions.

Instructor Grading and Feedback Response Time: A *tentative* guide for the overall course grade will be: $A \geq 90 > B \geq 80 > C \geq 70 > D \geq 60 > F$. The total grade contribution for quizzes and homework will for each be a maximum of 100% (e.g., working extra credit problems for homework will not be allowed to bring the homework part of the total grade to greater than 100%). Graded assignments typically will be returned within one week.

Course Policies

Late/Missing Work Policy: Please note that **it is the student's responsibility** to make up work as follows:

- Exams may be retaken due to (a) illness, or (b) a family emergency (verification will be required—see below). Make-up exams must be scheduled within 3 days of the student's return to classes. Please note that my make-up exams are equal to or exceed the original exam in difficulty.
    - If you are unable to attend class and would like to request a make-up exam, you should complete the university's Academic Notification process as soon as possible.
- Homework will be submitted via an on-line server, and credit can only be obtained if the homework is submitted on time. This means that your answers to the server must be submitted **prior to the posted time and date**: answers submitted after the posted time will receive 50% credit, even if the time at which you logged onto the server was prior to the posted time (!)
- Quizzes which are missed cannot be made up.

Course Attendance Policy: Attendance in lecture is **strongly encouraged**. Since the majority of material covered on exams will also be covered in class lectures and labs, those students who attend regularly and take good notes tend to have a definite advantage on exams. Those students having borderline grades at the end of the course **may** be helped toward the higher grade if they have maintained a very strong record of attendance ***and*** participation in the class.

Course Participation/Contribution: To be successful in this course, students are expected to read the textbook, complete homework assignments/quizzes/exams, attend class regularly, and ask and answer questions in class.

Course Calendar/Schedule: Here is a ***tentative*** schedule. The completion of one chapter sometimes may overlap with the next chapter material on a given day. **Note: Students are expected to come to class with the assigned material read beforehand.**

Tue. 8/23	**Discussion of Syllabus and Outcomes** Register for WileyPlus and work **Introductory Extra Credit assignment** on the WileyPlus website. (Due Fri 9/2 11:59 PM on WileyPlus)
Tue. 8/23-Tue. 8/30	**Ch. 18 Electric Forces and Electric Fields** (**Ch. 18 Homework** due Fri 9/2 11:59 PM on WileyPlus)
Thu. 9/1-Tue. 9/6	**Ch. 19 Electric Potential Energy and the Electric Potential** (**Ch. 19 Homework** due Wed 9/14)

Thu. 9/1	**Quiz 1**
Thu. 9/8-Thu. 9/15	**Ch. 20 Electric Circuits** (**Ch. 20 Homework** due Fri 9/23)
Tue. 9/20-Tue. 9/27	**Ch. 21 Magnetic Forces and Magnetic Fields** (Check WileyPlus for homework due dates for all remaining chapters.)
Thu. 9/29	**Exam I (Chs. 18-21)**
Tue 10/4-Thu 10/6	**Ch. 22 Electromagnetic Induction**
Tue 10/11	**Quiz 2**
Tue 10/11 – Thu. 10/13	**Ch. 24 Electromagnetic Waves**
Tue. 10/18	No Class (Fall Break)
Thu. 10/20-Thu. 10/27	**Ch. 25 and Ch. 26 The Refraction of Light: Lenses and Optical Instruments**
Tue. 11/1	**Exam II (Chs. 22, 24, 25, 26)**
Thu. 11/3-Tue. 11/8	**Ch. 27 Interference and The Wave Nature of Light**
Thu. 11/10	**Quiz 3**
Thu. 11/10-Tue. 11/15	**Ch. 28 Special Relativity**
Thu. 11/17-Tue. 11/22	**Ch. 29 Particles and Waves**
Thu. 11/24	No Class (Thanksgiving)
Tue. 11/29	**Quiz 4**
Tue. 11/29-Tue. 12/1	**Ch.30 The Nature of the Atom**
Thu. 12/8	**Final Exam 8:00 AM - 10:00 AM in GROTE 317 (Time and date set by UTC's Final Exam schedule. You must be here; you will not be able to take it early!)**

Homework Instructions: Homework in this class will be handled through WileyPlus. Each assigned problem will be individualized, leading to different numerical answers. It is strongly suggested that before you submit your answers for processing, you work your problems out on paper so that you will have a copy to study for exams. You should not expect to be able to solve all of the assigned problems --- but you should certainly try to work all of the assigned problems.

If you find that you cannot make any progress on a problem after first thinking **carefully** about it, then feel free to discuss it with me. I will be glad to help you with problems after you have made a reasonable effort to work them on your own.

Phys 1040L: General Physics Laboratory – Electromagnetism and Optics

Term:	Fall 2022
CRN:	40149 and 40683
Credits	1 credit hours
Location:	Virtual Classroom: UTC Learn (Canvas) and zoom
Faculty	Dr. Tatiana Allen, (Tatiana-Allen@utc.edu)
Dates/Time	Weekly live zoom meetings at https://tennessee.zoom.us/j/951981742 Wednesday, 10:00 a.m.
	Student Drop-In Hours in the zoom classroom https://tennessee.zoom.us/j/91694059722. Tuesday and Thursday 12:15-1:00 pm. If you cannot make it to my regularly scheduled drop-in hours, email me to set up a different time that works for both of us.

Course Catalog Description: Laboratory to accompany PHYS 1040. Experiments investigate various aspects of electromagnetism, electrical currents, instrumentation, optics, and radioactivity.

Corequisites: PHYS 1040 or department head approval.

Course Learning Outcomes (CLO):

CLO#1	Demonstrate conceptual understanding of physics principles and how they fit together to provide a coherent description of physical phenomena.
CLO#2	Demonstrate knowledge of physics vocabulary, including definitions of physical quantities and their units.
CLO#3	Demonstrate understanding of the relations between physical quantities (equations).
CLO#4	Demonstrate knowledge of instrumentation and computer technology to collect and analyze data.
CLO#5	Apply analytical methods to find relationships between physical quantities based on sets of data.

General Education Statement: This course fulfills a general education requirement of the university in the Natural Science Laboratory (SL) category *only* when taken in combination with Physics 1040.

General Education Outcomes: General education outcomes can be found at http://www.utc.edu/general-education/faculty-information/outcomes.php and are as follows:

Upon completion of the required credit hours in this category, students will be able to:

- Explain intellectual foundations, conceptual approaches, and methodologies of the natural sciences.
- Understand and explain scientific terminology.
- Discuss historical, social and political issues related to scientific data and advances.
- Construct graphic and analytical models from a description of a specific natural phenomenon.
- Formulate a hypothesis based on empirical data.
- Apply the scientific method to solve problems.
- Design experiments to test hypotheses.
- Express conclusions and implications from scientific experiments using a variety of methods.

Course Fees: Laboratory/studio course fee will be assessed.

Required Course Materials:
A. Laboratory Manual: Description of all experiments and other materials are available for studying/download from the course UTC Learn/Canvas page.

B. *Scientific* Calculator: You need to own one and use it for lab. It need not be a graphing calculator but should be able to perform calculations like the logarithm of a number, exponents, trigonometry, and work in scientific notation. You should familiarize yourself with how to use scientific notation and trigonometric functions on it. Calculators on cell phones and other personal electronic devices are not permitted.

Technology Requirements for Course:
- Access to a computer with a reliable internet connection and a Web Browser.
- Web camera.

Technology Skills Required for Course: You are expected to have a working knowledge of using email, UTC Learn (CANVAS), web applications, YouTube, internet search engines, Microsoft Word, Microsoft Excel, Microsoft PowerPoint, and Adobe Acrobat to complete course requirements.

Communication:
All items in this syllabus are tentative. Class announcements will be made through UTC Learn (CANVAS). Please enable automatic notifications of CANVAS announcements. Check your UTC email and UTC Learn (CANVAS) on a regular basis. **It is the responsibility of the student to keep informed of any changes made in assignments, exam and/or homework due dates, or changes in the course format itself, new materials, missed content. Students are also responsible for all information given in the course.**
Email is **the best way** to contact me. Inquiries will be replied to as soon as possible, usually within 24-48 hours on workdays. **Please note** that if several students email with the same question, I usually reply by **posting an announcement** through UTC Learn instead of answering individually. Sometimes, although extremely rarely, my e-mail client puts incoming emails into TRASH folder, so I do not see them. If I have not replied to your email in 3 (three) business days, this might be the case. Please email again.

Preferred Names: If your preferred name is not the same as the name that appears on the university provided roster for the course, please let me know so that I can use your preferred name. Please use your official or preferred name when login to zoom, so I can identify you.

Course Structure:
The course is organized by weekly activity, one experiment per week. A week will run from Thursday to Wednesday. For each experiment the study/experimental materials will be posted on Canvas on Thursday, so students can start working on the experiment and the lab report. This work will be done in groups of two students (lab partners). A quick quiz which needs to be done individually on Canvas will be due on Tuesday night. On Wednesday we will have a zoom session where students can ask any questions regarding the experiment. The lab report will be due on Wednesday night. On Thursday the lab materials for next lab will be posted.
There will be two exams, midterm and final. **Exams** will be administered through Canvas. Exam grades (but not the grades for other assignments) will be normalized ***if necessary***.

Course Participation/Contribution: You are expected to complete all scheduled activities and attend every zoom session. This is a one credit course, so you should expect to spend 4-5 hours per week on this course.

Course Deadlines: Each assignment will have a posted deadline. *It is your responsibility to plan ahead so that your work is turned in on time.* Work that is submitted online will receive credit only if submitted on time: this means that your work should be submitted prior to the posted date and **time**. Information submitted **after** the posted time will be refused by the server, even if the time at which you logged onto the server was prior to the deadline.

Late/Make-Up Work Policy:

- Life happens; therefore, I drop the lowest grade in each category of assignments (1 lab report and 1 quiz), no questions asked.
- If you experience a life situation such as a serious illness or family emergency that makes it difficult for you to meet the deadlines, please email me **before the deadline,** if you can. You also should contact the Student Outreach and Support (SOS) services and complete the Academic Notification process as soon as possible. The SOS office will review your documentation and may request accommodations based on your situation. As soon as I receive the letter from the SOS office, I will work with you on the deadlines.
- All make up work should be completed within one week of your return to school, but no later than Friday, December 2nd.
- **No extra credit work may be done to substitute for low grades or missed assignments.**

Course Grading Policy: a **tentative** grading plan will be as follows:

Weekly work: quizzes, lab reports, etc. (the lowest one will be dropped):	50%
Midterm exam	25%
Final exam	25%
Total	**100%**

Grading Scale and Feedback Response Time:

Final Grade	Percentages	Definitions
A	**90%-100%**	**"A"** represents an evaluation of work which **exceeds** competency standards, depicts mastery, and demonstrates an exceptional understanding of the subject matter.
B	**80%-89%**	**"B"** represents an evaluation of work which **meets** competency standards for thoroughness and depicts a thorough understanding of the subject matter.
C	**70%-79%**	**"C"** represents an evaluation of work that is **satisfactory** relative to standards of competency but lacks some areas of thorough understanding of the deliverables and the subject matter.
D	**60%-69%**	**"D"** represents marginal performance below the acceptable standards of university work.
F	**<60%**	**"F"** indicates unqualified failure and the necessity for repeating the course to obtain credit.

Final grades will be rounded precisely. If you have an 89.4% final average, this is a B. If you have a 69.5%, this is a C. UTC does not use +/- grades. **No extra credit work may be done to substitute for low grades or missed assignments. No exceptions.**

Instructor Grading and Feedback Response Time: The grades for lab reports and exams will be posted on the UTC Learn as soon as the exam is graded (usually within 14 days). Please check the online grade

book ("My Grades" on Canvas) for the grades. **If you notice an error with a grade, you must contact me within one week of the grade being posted** to discuss the problem.

Plagiarism Detection: Assignments in this class will be submitted to UTC Learn (Canvas). The instructor may submit papers to the UTC Learn text-matching software for review and analysis of originality and intellectual integrity. If the results of the review indicate academic dishonesty, disciplinary action may be taken against the student (participant) as outlined in the UTC Student Handbook.

Please read and study the **CAMPUS SYLLABUS** that provide you with important information related to all UTC classes such as academic integrity, student conduct and pledges, academic support resources, student health and wellness, UTC-alert system, covid-19-related information and policies, etc.
A copy of the Campus Syllabus is available in the same folder on Canvas.

Schedule (tentative, the dates can change; the announcements will be posted on UTC Learn/ CANVAS)

Week	Dates	Material/ Assessment
1	8/22 – 8/28	**No Lab this week**
2	8/29 – 9/04	Inverse Square Relationships
3	9/05 – 9/11	Ohm's Law and Equivalent Resistances
4	9/12 – 9/18	The Wheatstone Bridge and Resistivity
5	9/19 – 9/25	Circuits with Resistors and Capacitors
6	9/26 – 10/02	Magnetic Fields
7	10/03 – 10/09	**Mid-term exam (Wednesday, 10/05, during the class time)**
8	10/10 – 10/16	The Polarization of Light
	10/17 – 10/18	**Fall break**
9	10/19 – 10/23	Reflection and Refraction of Light
10	10/24 – 10/30	Images Produced by Thin Lenses
11	10/31 – 11/6	Interference and Diffraction of Light
12	11/7 – 11/13	Spectral Lines of Mercury
13	11/14 – 11/20	Decay of Radioactive Elements
	11/21 – 11/27	**No Lab this week (11/23-11/27 = Thanksgiving Holiday)**
14	11/28 – 12/4	**No Lab this week**
		Final exam: Friday, December 9th, 8-10 a.m. https://www.utc.edu/enrollment-management-and-student-affairs/registrar/calendars-and-schedules/fall-2022

The University of Tennessee at Chattanooga

The First Year Experience

Fall 2023

PHYS,1250, 46064, Face-to-Face, 1 credit hour

Instructor: Dr. Luis Sanchez Diaz

Email and Phone Number: luis-sanchezdiaz@utc.edu and 423-425-4513

Office Hours (Student support) and Location: Monday 9am-10am, 12pm-1pm, Thursday from 12pm-1pm and Friday on zoom 11am-12pm. Grote 201.Friday on zoom by appointment.

Course Meeting Days, Time, and Location: Thu. 10:50 AM – 11:45 AM, Grote 213

Course Catalog Description: An introduction to the University academic environment, including the nature and purpose of a college education, expectations for academic success, learning beyond the classroom, academic and career planning, and student engagement resources and opportunities at UTC and within the Chattanooga community. Elective available to all students with fewer than 30 earned hours. Recommended during the initial semester for students who enter UTC with fewer than 15 hours. The UTC Experience is designed to help the students' transition from high school to college, to facilitate students' integration into academic life, and to provide students the opportunity to explore academic and career options at the university. Students enrolled in this course will earn one hour of graded, elective credit.

Course Pre/Co Requisites: There are no pre- or co-requisites.

Course Student Learning Outcomes:

- Students will acknowledge personal skills, abilities, and areas of growth.
- Students will identify ways in which they can build supportive relationships on campus and in the community.
- Students will identify resources to support their academic success.
- Students will demonstrate an awareness of the connections between culture and identity within themselves and others.

Required Course Materials: There are no materials to purchase at the bookstore. This course uses a free online textbook, *College Success*, available at: https://openstax.org/details/books/college-success. Other course materials will be available in weekly modules in Canvas.

Course Type/Delivery: This course will be face-to-face classroom instruction.

Technology Requirements for Course: To enhance student services, the University will use your UTC email address for communications. You must also log into the UTC Canvas learning management system (UTC Learn). You are responsible for all mail sent to your UTC email and information on Canvas. Check them both

regularly. Please email me questions, and I will answer them as promptly as possible. Make every effort to complete and turn in assignments well before the due date to avoid any panic in meeting assignment deadlines.

Technology/Digital Literacy Skills Required for Course: You need access to a computer with a reliable internet connection. In addition, you must be able to access Zoom and have a camera so you can join both through video and audio if needed. Test your computer setup and browser for compatibility with UTC Learn (Canvas) at https://community.canvaslms.com/docs/DOC-10721. You are also expected to have working knowledge of internet search engines, Microsoft Word and Microsoft PowerPoint to complete course requirements.

UTC Email and Communication: To enhance student services, UTC uses UTC email addresses for all communications. Your email account is provided as part of your MyMocsNet account. You must know how to use your UTC email and should check it daily for timely receipt of class announcements and other important information. If you have difficulties accessing your account or UTC Learn, contact the IT Help Desk at (423) 425-4000.

Technology: Visit Get Started with IT for your step-by-step guide to technology on campus. If you have problems with your UTC accounts or with the Canvas learning management system (UTC Learn), contact IT Help Desk at (423) 425-4000, email, or submit a ticket. Walk in support is also available in the IT Solution Center. If you have technology needs to access your courses and/or complete course requirements in Canvas, submit a request with Information Technology.

Course Assessments and Requirements (due dates are posted on course schedule):

Activity	Deliverable	Points	Percent total of Final Grade
Participation/Course Assignments	Meaningful Contributions During Class (involves in-class instruction and out of class activities (ex: Peer mentor activities, scavenger hunt etc.)	400	40%
"Dear Me": Reflection Letter	Written Reflection and Goal Setting Letter	75	7.5%
Cultural Perspective Photo Assignment	Photo and short reflection	75	7.5%
Library Assignment	Attendance & Active Participation	75	7.5%
Campus and Community Involvement	Reflection 1	75	22.5%
	Reflection 2	75	
	Reflection 3	75	
Blue and Gold Project Plan	Tentative plan for final Blue and Gold Experience Project	50	5%
Blue and Gold Project	Presentation to Class on First Semester Experience	100 final	10%
	TOTALS	**1000 Points**	**100%**

	"Dear Me"	Campus & Community Involvement	Library & Research	Culture & Diverse Perspectives	"Blue & Gold"
SLO 1	X	X	X	X	X
SLO 2	X	X		X	X
SLO 3		X	X		X
SLO 4		X		X	X

Course Grading

Grading Scale			
Final Grade	**Points**	**Percentages**	**Definitions**
A	900-1000	90-100	**A** represents an evaluation of work which **exceeds** competency standards, depicts proficiency, and demonstrates a thorough understanding of the subject matter.
B	800-899	80-89	**B** represents an evaluation of work which **meets** competency standards for thoroughness and depicts an understanding of the subject matter.
C	700-799	70-79	**C** represents an evaluation of work that is **satisfactory** relative to standards of competency but lacks some areas of understanding of the deliverables and the subject matter.
D	600-699	60-69	**D** represents an evaluation of work that does not meet standard of competency and lacks areas of understanding of the deliverables and the subject matter.
F	0-599	0-59	**F** represents **unsatisfactory** work.

Instructor Grading and Feedback Response Time: Grading by the instructor will be completed within 7 days of the posted deadline.

Course Policies

Late/Make-Up Work Policy: Make-up assignments for missed in-class assignments will not be provided. Late assignments will be accepted within 72 hours after the due date. Late assignments may be submitted with a 10-point per day deduction.

Course Deadlines: All assignments must be completed and submitted via Canvas learning management system (UTC Learn) by **the due date** listed in the course schedule. *It is your responsibility to plan ahead so that assignments are turned in on time.*

Attendance Policy: Attendance for this class is expected each week (face-to-face). Due to the nature of the course, each week will include assignments and participation points unable to be earned due to an absence.

Tardy – Being tardy is not acceptable. Being tardy three times will result in an unexcused absence.

Course Participation/Contribution: Active course participation is required of all students in class, virtually (Zoom), and in Canvas.

Course Calendar/Schedule: See UTC Learn (Canvas) for course schedule.

Date	Topic/Course Outcomes	Activities	Assignments and Due Dates
Week 1 8/24	**FYE/Exploring College** • *Students will acknowledge personal skills, abilities, and areas of growth.* • *Students will identify ways in which they can build supportive relationships on campus and in the community.*	Icebreaker Introduce syllabus Discussion Why Go to College? Unpack Baggage…Throw it Away Discuss "Dear Me" Reflection Letter Assignment	"Dear Me" Reflection Letter Due: (31 Aug 2021, 11:59PM)
Week 2 8/31	**Time Management** • *Students will acknowledge personal skills, abilities, and areas of growth.* • *Students will identify resources to support their academic success.*	What does your weekly schedule look like in college vs last year? Bring syllabi and add all tests/assignments for the semester Play-Doh Activity	Semester Planner- Choose a planner (paper, electronic, app) and add all major dates for all courses. Due: Complete in Class
Week 3 9/7 (Labor Day holiday 9/4)	**UTC Campus (Resources)** • *Students will acknowledge personal skills, abilities, and areas of growth.* • *Students will identify ways in which they can build supportive relationships on campus and in the community.* • *Students will identify resources to support their*	Campus Resources Scavenger Hunt (leave the classroom)	Physics and Chemistry Photo Scavenger Hunt Due (9 Sept 2021, 11:59 PM)

	academic success. • *Students will demonstrate an awareness of the connections between culture and identity within themselves and others.*		
Week 4 9/14	**Civility and Cultural Competence** • *Students will identify ways in which they can build supportive relationships on campus and in the community.* *Students will demonstrate an awareness of the connections between culture and identity within themselves and others.* •	PowerPoint Presentation on Diversity In-class discussion Cultural Perspective Photo	
Week 5 9/21	**Social and Civic Engagement** • *Students will acknowledge personal skills, abilities, and areas of growth.* • *Students will identify ways in which they can build supportive relationships on campus and in the community.* • *Students will demonstrate an awareness of the connections between culture and identity within themselves and others.*	Reflections on Identity Activity UTC Civic Engagement video Hopes and Concerns about Relationships	Challenger Center Team Building Exercise: Attendance is required. Meet at Challenger Center and complete assignment
Week 6 9/28	**Academics Success** • *Students will acknowledge personal skills, abilities, and areas of growth.* • *Students will identify ways in which they can build supportive relationships on campus and in the community.* • *Students will identify resources to support their academic success.*	What is Critical Thinking? Think Achieve Website/Program Critical Thinking Scenarios activity UTC Writing & Communication Center website overview Explore writing techniques Career Connection Activity	Campus and Community Involvement Reflection 1 Due: (21 Sept 2023, 11:59PM)
Week 7 10/05	**Studying and Test Taking** • *Students will acknowledge personal skills, abilities, and areas of growth.* • *Students will identify resources to support their academic success.*		Blue and Gold Experience Draft Due: 10/19 at 11:59pm

Week 8 10/12	**Health and Mental Wellness** • *Students will acknowledge personal skills, abilities, and areas of growth.* • *Students will identify ways in which they can build supportive relationships on campus and in the community.* Faculty notify undergraduate students of mid-term grades Sept 27-Oct. 8th	Visit the ARC Suicide Prevention Module	
Week 9 10/19 (Fall Break 10/16 & 10/17)	**Chemistry and Physics department information** **Guest speaker**		Campus and Community Involvement Reflection 2 Due: 10/25 at 11:59pm
Week 10 10/25	**Reading and Notetaking** • *Students will acknowledge personal skills, abilities, and areas of growth.* • *Students will identify resources to support their academic success.*		
Week 11 11/02	**Library** • *Students will identify resources to support their academic success.* • *Students will demonstrate an awareness of the connections between culture and identity within themselves and others.*		Library assignment: Completed in class.
Week 12 11/09	**Financial Literacy** • *Students will acknowledge personal skills, abilities, and areas of growth.* • *Students will identify resources to support their academic success.*	UTC Financial Wellness Website / guest speaker In-class develop budget or search your career starting salary	Develop a monthly budget and research first year salary for your intended career Due: 11/16 at 11:59pm
Week 13 11/16	**Career and Leadership Pathways** • Students will acknowledge personal skills, abilities, and areas of growth.	Dr. Rob Liddell Guest Speaker Exploring Majors PPT	Print and annotate clear path for the major you have

	• Students will identify ways in which they can build supportive relationships on campus and in the community. • Students will identify resources to support their academic success. • Students will demonstrate an awareness of the connections between culture and identity within themselves and others.	Occupational Handbook Introduction to clear path/Catalogue	declared, or you are interested. Bring to class on
Week 14 11/20-11/24 (Thanksgiving Break 11/22-11/24)	**No class**		Campus and Community Involvement Reflection 3 Due: 11/30 at 11:59pm
Week 15 11/30	**Blue and Gold Presentations in Class** • Students will acknowledge personal skills, abilities, and areas of growth. • Students will identify ways in which they can build supportive relationships on campus and in the community. • Students will identify resources to support their academic success. • Students will demonstrate an awareness of the connections between culture and identity within themselves and others.		Blue and Gold Experience Presentation Due: 11/30
Week 16 Class 12/4 Last Day of Classes	**Blue and Gold Presentations in Class** • Students will acknowledge personal skills, abilities, and areas of growth. • Students will identify ways in which they can build supportive relationships on campus and in the community. • Students will identify resources to support their academic success. • Students will demonstrate an awareness of the connections between culture and identity within themselves and others.		

Campus Syllabus: https://www.utc.edu/academic-affairs/campus-syllabus

Key Resources and Links for Students

- Mocs One Center: https://www.utc.edu/enrollment-management-and-student-affairs/mocs-one-center
- Center for Academic Support and Advisement: https://www.utc.edu/enrollment-management-and-student-affairs/academic-support-and-advisement
- Office of Multicultural Affairs: https://www.utc.edu/enrollment-management-and-student-affairs/multicultural-affairs
- Center for Women and Gender Equity: https://www.utc.edu/enrollment-management-and-student-affairs/center-for-women-and-gender-equity
- Information Technology: https://www.utc.edu/information-technology
- Veteran Student Services: https://www.utc.edu/enrollment-management-and-student-affairs/veteran-student-services
- Course Catalog: https://www.utc.edu/enrollment-management-and-student-affairs/registrar/course-catalogs
- Academic Calendar and Final Exam Schedule: https://www.utc.edu/enrollment-management-and-student-affairs/registrar/calendars-and-schedules
- Academics and Majors: https://www.utc.edu/about/academics-and-majors
- Registrar: https://www.utc.edu/enrollment-management-and-student-affairs/registrar
- UTC Bookstore: https://www.utc.edu/finance-and-administration/auxiliary-services/bookstore
- UTC Library: https://www.utc.edu/library
- Housing and Residence Life: https://www.utc.edu/enrollment-management-and-student-affairs/housing
- Dean of Students: https://www.utc.edu/enrollment-management-and-student-affairs/dean-of-students
- Campus Recreation: https://www.utc.edu/enrollment-management-and-student-affairs/campus-recreation
- Auxiliary Services: https://www.utc.edu/finance-and-administration/auxiliary-services
- Center for Career and Leadership Development: https://www.utc.edu/enrollment-management-and-student-affairs/center-for-career-and-leadership-development
- The Counseling Center: https://www.utc.edu/enrollment-management-and-student-affairs/counseling-center
- Think Achieve: https://www.utc.edu/academic-affairs/walker-center-for-teaching-and-learning/thinkachieve
- Title IX: https://www.utc.edu/enrollment-management-and-student-affairs/title-ix
- UTC Police: https://www.utc.edu/finance-and-administration/emergency-services/police
- Aquatic and Recreation Center: https://www.utc.edu/enrollment-management-and-student-affairs/campus-recreation/facilities/arc
- Writing and Communication Center: https://www.utc.edu/library/services/writing-and-communication-center
- Center for Academic Support and Advisement: Supplemental Instruction: https://www.utc.edu/enrollment-management-and-student-affairs/center-for-academic-support-and-advisement/supplemental-instruction
- Financial Aid and Scholarship: https://www.utc.edu/enrollment-management-and-student-affairs/financial-aid-and-scholarships

- University Health Services: https://www.utc.edu/enrollment-management-and-student-affairs/university-health-services
- Office of the Bursar: https://www.utc.edu/finance-and-administration/bursar

The University of Tennessee at Chattanooga

Principles of Physics: Mechanics and Heat

Fall 2022

PHYS, 2300, CRN 40155, face to face, 3 credit hours

Instructor: Dr. Luis E. Sanchez-Diaz

Email and Phone Number: luis-sanchezdiaz@utc.edu, (423) 425-4546 and Zoom Meeting ID 9586199280 Password 9zVrT8

Office Hours and Location: Monday 2:00PM to 8:00PM, Tuesday 8am to 10am in Grote Hall room 201. If you cannot attend my office hours, please email me with your questions any time; I will respond within 24 hours. Zoom appointments are available as needed.

Course Meeting Days, Times, and Location: TR (1:40PM – 2:55 PM) in Grote Hall 103. Please arrive on time so that you do not miss any announcements.

Course Catalog Description Calculus-based introduction to forces and uniform motion, conservation principles, sound and thermodynamics, with applications to problems of modern science and technology. Every semester. Lecture 3 hours. Click here to enter text.

Course Pre/Co Requisites: Calculus-based introduction to the laws of classical dynamics, kinematics, and thermodynamics, with applications to simple physical systems. Every semester. Lecture 3 hours. Pre- or Corequisite: MATH 1920 or MATH 1960 with minimum grade of C or department head approval. Corequisite: PHYS 2300L laboratory or department head approval. Standard letter grade.

Course Student Learning Outcomes: This course is certified as a General Education course fulfilling the Natural Science (with lab component) category when taken in combination with Physics 2300. Upon completion of the required credit hours in this category, students will be able to:

- Explain intellectual foundations, conceptual approaches, and methodologies of physics as they apply to mechanics.
- Understand and explain scientific terminology applicable to mechanics.
- Discuss historical, social and political issues related to scientific data and advances.
- Construct graphic and analytical models from a description of a specific natural phenomenon.
- Formulate a hypothesis based on empirical data.
- Apply the scientific method to solve problems.

- Design experiments to test hypotheses.
- Express conclusions and implications from scientific experiments using a variety of methods.

General Education Student Learning Outcomes: Physics 2300 and 2300L are certified as general education courses fulfilling in Natural Science with Laboratory (SL) courses. The overall outcomes for the category are:

Students will explain how scientific knowledge develops over time as new evidence emerges.
- Students will demonstrate scientific literacy by locating, evaluating, interpreting, and applying scientific information/data.
- Students will explain how scientific developments impact society.
- Students will demonstrate the connection between scientific theory and application.

Students will apply the methods of science by testing hypotheses and reporting the results.

Required Course Materials: Our *required text* will be Fundamentals of Physics, 10th ed.,11 or 12 by Halliday, Resnick, and Walker, Hoboken, New Jersey, John Wiley & Sons, Inc., c. 2014. Previous edition is good. For homework, we will WileyPlus. Please enroll using PDF flyer on canvas

***Scientific* Calculator**: You will be expected to use one, so own one and bring it every time. It need not be a graphing calculator but should be able to perform calculations like taking the logarithm of a number, exponents, and trigonometric functions. It should also be capable of handling scientific notation (which will be explained in class). *Cell phones cannot be used as calculators.*

Technology Requirements for Course: You need access to a computer with a reliable internet connection to complete this course. Test your computer set up and browser for compatibility with UTC Learn at http://www.utc.edu/learn/getting-help/system-requirements.php. As there are videos with sound that you must watch, you will also need speakers or headphones. You should also have an updated version of Adobe Acrobat Reader, available free from https://get.adobe.com/reader/.

Technology Skills Required for Course: These include using Microsoft Word and Excel, using the learning management system (UTC Learn), using MOCSNet email, creating and submitting files to UTC Learn, copying and pasting, and downloading and installing software. As there are videos with sound that you must watch, you will also need speakers or headphones.

Technology Support: If you have problems with your UTC email account or with UTC Learn (Canvas), contact IT Help Desk at 423-425-4000 or email helpdesk@utc.edu.

Student Technology: If you have technology needs to access your courses and/or complete course requirements in Canvas, submit a request (https://new.utc.edu/information-technology/learning-from-home) with Information Technology.

Student Accommodations: If you have accessibility and accommodation requests, contact the Disability Resource Center (https://www.utc.edu/disability-resource-center/index.php) at 423-425-4006 or email DRC@utc.edu

Course Assessments and Requirements: (due dates are in the course calendar).

Homework	25%
3 Tests	60%
Best 2 of 3 Quizzes*	15%
Total	100%

As evaluative measures, there will be three scheduled 65 min tests, 4 brief (20-25 min.) quizzes. **Students are expected to come to class with the assigned material read beforehand.**

Homework will be posted in CANVAS. Student will upload on canvas the homework before the due date.

Course Grading

Course Grading Policy: 90-100% = A; 80-89% = B; 70-79% = C, 60-69% = D; <60% = F. Final grades will be rounded precisely. If you have an 89.4% final average, this is a B. If you have a 69.5%, this is a C.

Instructor Grading and Feedback Response Time: I will try my best to grade all assignments within one week of the due date and provide written feedback when necessary.

Course and Institutional Policies

Late/Missing Work Policy: Homework may be submitted up to two (2) days late with a 5% deduction for each late day. Test may not be taken late. However, if you will miss an exam due to a planned event, you may take the exam early by contacting the professor at least three (3) days in advance. No exams will be given after the scheduled date/time.

Student Conduct Policy: UTC's Student Code of Conduct and Honor Code (Academic Integrity Policy) can be found on the Student Conduct Policy page (https://www.utc.edu/student-conduct/codes.php).

Honor Code Pledge: As a student of the University of Tennessee at Chattanooga, I pledge that I will not give or receive any unauthorized assistance with academic work or engage in any academic dishonesty in order to gain an academic advantage. I will exert every effort to insure that the Honor Code is upheld by myself and others, affirming my commitment to a campus-wide climate of honesty and integrity

Course Attendance Policy: Each student is expected to attend every class and maintain an environment conducive to learning. This means being respectful to fellow classmates, the instructor, and any visitors who may be present. Students are required to attend class.

Click here to enter text.

Course Learning Evaluation: Course evaluations are an important part of our efforts to continuously improve the learning experience at UTC. Toward the end of the semester, you will receive a link to evaluations and are expected to complete them. We value your feedback and appreciate you taking time to complete the anonymous evaluations.

UTC Bookstore: The UTC Bookstore will price match Amazon and Barnes and Noble (https://www.barnesandnoble.com/) prices of the exact textbook - same edition, ISBN, new to new format, used to used format, and used rental to used rental format, with the same rental term. For more information, go to the Bookstore Price Match Program (https://bnc.pgtb.me/MMt77F), visit the bookstore, email sm430@bncollege.com or call 423-425-2184.

Course Calendar/Schedule: Please check UTC learn for the Homework and Discussion forum due dates.

Week 1: Tu.08/23-Th. 08/25 **Ch.1 Introduction and Mathematical Concepts.**

Week 2: Tu. 08/30-Th. 09/01 **Ch.2 Kinematics in One Dimension.**

09/02 Due date: Homework 1

Week 3: Tu. 09/06-Th. 09/08 **Ch.3 Kinematics in Two Dimension**

09/02 Quiz 1(Ch 1 and 2)

Week 4: Tu. 09/13-Th. 09/15 Unit 7: **Ch.4 Forces and Newton's Laws of Motion**

09/16 Due date: Homework 2

Week 5: Exam

09/20 Test 1 (Ch. 1,2,3, 4)

09/20 Due date: Homework 3

Week 6: Th. 09/22-Tu. 09/27 : **Ch.6 Dynamics of Uniform Circular Motion**

09/28 Due date: Homework 4

Week 7: Th. 09/29-Tu. 10/04: **Ch.7 and 8 Work and Energy.**

10/07 Due date: Homework 5

10/04 Quiz 2 (Ch 6 and 7)

Week 8: Th. 10/06-Tu. 10/11: **Ch.9 Impulse and Momentum**

10/14 Due date: Homework 6

Week 9: Th. 10/13- Th. 10/20 **Ch.10 Rotational Kinematics and Ch.11 Rotational Dynamics**

10/18 Fall break

10/22 Due date: Homework 7

Week 10: Exam

10/25 Test 2 (Ch. 6, 7, 8, 9, 10)

Week 10: Th. 10/27-Tu. 11/01 : **Ch.12 Elasticity and Ch.13 Fluids**

11/02 Due date: Homework 8

Week 11: Th. 11/03-Tue. 11/08 : **Ch.18 Temperature and Heat Law and Kinetic Theory**

11/10 Due date: Homework 9

11/08 Quiz 3 (Ch 12 and 13)

Week 12: Th. 11/10-Tue. 11/15: **Ch.19 Thermodynamics**

11/16 Due date: Homework 10

Week 13: Th. 11/17-Tue. 11/22: **Ch.15 Simple Harmonic Motion and Ch.16 Waves and Sound**

11/24 THANKSGIVING

Week 14: Tu. 11/29-Th. 12/01: **Waves and Sound**

12/02 Due date: Homework 11

12/08 Test 3 (Ch. 12,13,15,16 and 18) 1-3pm

The University of Tennessee at Chattanooga

Principles of Physics Laboratory: Mechanics and Heat

Phys 2300L-0 CRN 40157, Face to Face, 1 credit hour.

Instructor: Mr. Jeremy F. Stewart

Email: jeremy-stewart@utc.edu

Office Hours and Location: Monday 10:00am – 11:30pm, Wednesday 10:00am – 11:30am, Grote Hall room 221. If you cannot attend my office hours, please email me with your questions. Virtual appointments are available as needed

Course Meeting Days, Time, and Location: Tuesday, 3:00PM - 4:50PM, Grote 214

Course Catalog Description: Physics 2300L Principles of Physics Laboratory - Mechanics and Heat (1 credit hr.) Laboratory to accompany PHYS 2300. Experiments investigate basic laws of motion, conservation principles, waves and oscillations, and heat measurements with emphasis given to error analysis. Laboratory 2 hours. Corequisite: PHYS 2300. Corequisite: MATH 1950, or Prerequisite: MATH 1950 with a minimum grade of C, or department head approval. Laboratory/studio course fee will be assessed

Course Student Learning Outcomes: This course is certified as a General Education course fulfilling the Natural Science (with lab component) category when taken in combination with Physics 2300. Upon completion of the required credit hours in this category, students will be able to:

- Explain intellectual foundations, conceptual approaches, and methodologies of physics as they apply to mechanics.
- Understand and explain scientific terminology applicable to mechanics.
- Discuss historical, social and political issues related to scientific data and advances.
- Construct graphic and analytical models from a description of a specific natural phenomenon.
- Formulate a hypothesis based on empirical data.
- Apply the scientific method to solve problems.
- Design experiments to test hypotheses.
- Express conclusions and implications from scientific experiments using a variety of methods.

Course Pre/Co Requisites: Co-requisite: Physics 2300. Co-requisite: Math 1950, or prerequisite Math 1950 with a minimum grade of C or department head approval.

General Education Statement: Physics 2300 and 2300L together fulfill 4 credit hours of the general education requirement in Natural Science Laboratory (SL) courses. Please consult with your advisor and check the specific requirements for your major to determine if this course is a good fit for your plan of study.

Course Materials/Resources:

A. Laboratory Manual: The lab manual by Dr. Kristen B. Whitson (including experiment descriptions, pre-lab, and report pages for all lab sessions) is posted at the class website on Canvas.

B. *Scientific* Calculator: You need to own one and bring it to lab. It need not be a graphing calculator but should be able to perform calculations like the logarithm of a number, exponents, trigonometry, and work in scientific notation. You should familiarize yourself with how to use scientific notation and trigonometric functions on it. ***Calculators on cell phones and other personal electronic devices are not permitted.***

C. It will be assumed that you have a copy of the text currently in use for Physics 2300.

Course Fees: Lab Fee Assessed

Course Assessments and Requirements: The weighting of the overall course grade is tentatively set forth below. Students will be notified in class if a reassignment of weights becomes necessary.

Best 10 of 11 lab reports	=	75%
Final Exam	=	25%
		100%

Lab reports will be graded for both form and content. Points will be subtracted from reports which are messy or illegible. If all 11 assignments are completed, the lowest grade will be dropped. There will be a make-up lab at the end of the semester. **Only one lab can be made-up**.

Grading Scale: Tentative grading scale: A ≥ 90 > B ≥ 80 > C ≥ 70 > D ≥ 60 >F.

Attendance Policy: Attendance in all PHYS2300L lab sessions is ***mandatory***.

Policy for Late/Missing Work: *Missed labs* must be rescheduled at the convenience of the instructor and any lab partners who may be necessary. *Late lab reports* **will not be accepted without the instructor's prior permission.** If you must miss a lab session, that session should be made up as soon as possible. No more than **one** missed laboratory session may be made up.

Please Note: All items in this syllabus are tentative. Changes in the lab assignment, lab report due date, or even changes in the course format itself will be announced in the lab and on

Canvas class. It is the responsibility of the student to stay abreast of any such changes made in the laboratory.

1. The worksheets and exercises performed during the first two lab sessions are due at the beginning of the next lab session after the work is performed. **Please read the introductory section "How to write your lab report" before coming to the first class.**

2. Lab reports will be written for the last 9 laboratory exercises. For these, the *hand-written* pre-lab portion of each lab report (objective, theory, and procedure) is due at the beginning of the session in which the experiment will be performed. The instructor will keep this portion and put it together with the rest of your lab report. Printed copies of the last portion of all reports are due at the beginning of the next regular laboratory session. This includes your data, calculations/graphs, results and discussion. The components needed for individual lab reports will be listed at the end of the description for that lab. In general, the points will be divided as follows. Note that the professionalism of the report will be assessed by the "Style" portion of your grade.

Pre-lab (goals, background, apparatus, methods)	20 pts.
Experimental data	25
Calculations/Graphs	25
Results and Discussion	25
Style	5
	100 pts. total

Accommodation Statement: If you are a student with a disability (e.g. physical, learning, psychiatric, vision, hearing, etc.) and think that you might need special assistance or special accommodations in this class or any other class, contact the Disability Resource Center (DRC) at (423) 425-4006 or come by the office, 317 University Center.

Counseling Statement: If you find that you are struggling with stress, feeling depressed or anxious, having difficulty choosing a major or career, or have time management difficulties which are adversely impacting your successful progress at UTC, please contact the Counseling and Personal Development Center at (423) 425-4438 or go to utc.edu/counseling for more information.

Veterans Services Statement: The office of Veteran Student Services is committed to serving all the needs of our veterans and assisting them during their transition from military life to that of a student. If you are a student veteran or veteran dependent and need any assistance with your transition, please refer to http://www.utc.edu/greenzone/ or http://www.utc.edu/records/veteran-affairs/. These sites can direct you the necessary resources for academics, educational benefits, adjustment issues, veteran allies, veteran organizations, and all other campus resources serving our veterans. You may also contact the coordinator of Veteran Student Programs and Services directly at (423) 425-2277.

Tentative Schedule:

Lab	**Date**
Data Processing	8/30
Graphical Analysis of Data	9/6
Acceleration Due to Gravity	9/13
Projectile Motion	9/20
Resolution of Forces	9/27
Work and Friction	10/4
Conservations Laws	10/11
Fall Break	10/18
Simple Pendulum	10/25
Spring Constant	11/1
Standing Waves on a String	11/8
Specific Heat	11/15
No Lab/Last Lab Due	11/22
Final Exam	11/29

The University of Tennessee at Chattanooga

Syllabus of Phys 2310

Fall 2022, August 22 to December 13, 2022

Department of Chemistry and Physics, Phys 2310, Section 0 CRN 40156 3.0 credit hr.

Instructor: Ling Jun Wang

Email and Phone Number: lingjun-wang@utc.edu, 423-425-5248

Office Hours and Location:

Mon. & Tue. 3:20 – 4:20, Wed. 9:00 – 11:00, 1:00 – 2:00, 3:20 – 4:00, Grote 204

Course Meeting Days, Times, and Location:

TT. 12:15 -1:30, Grote 131

Course Catalog Description: Calculus based introduction to electric and magnetic fields, electric currents, electromagnetic induction and waves. For all physics and engineering students.

Course Pre/Co Requisites: **Prerequisites:** a. Engr 103, 104, or Phys 104, or Phys 230; b. Math 150, 160. **Co-requisite:** Phys 2310Lab.

Course Student Learning Outcomes: The students are expected to understand the theory and applications of electricity and magnetism, historical development and methodology of the theory, scientific terminology, social and political implications of the electrical engineering, and know how to use data and graphics to solve problems.

General Education Statement: *3 credits of Gen Ed courses in the Natural Science category.*

General Physics: Electromagnetism and Optics

Fall 2022

PHYS 1040, CRN 40148, Face-to-Face, 3 credit hours

Instructor: Dr. Josh Hamblen

Email and Phone Number: Joshua-Hamblen@utc.edu, (423)425-5392

Office Hours and Location: Tue 11-12, Thu 11-12, Fri 11-12 Grote 205
(You're welcome to schedule an alternate meeting time with me as well.)

Course Meeting Days, Times, and Location: Tue. Thu. 9:25 AM-10:40 AM, GROTE 317

Course Catalog Description: Algebra-based introduction to classical electricity and magnetism, optics, and the concepts of modern physics. Lecture 3 hours.

Course Pre/Co Requisites: Prerequisite: PHYS 1030 and PHYS 1030L, or department head approval. Corequisite: PHYS 1040L, or Prerequisite: PHYS 1040L, or department head approval.

Course Student Learning Outcomes: Welcome to the second part of General Physics! The objectives of this course are to help you develop a conceptual understanding, basic vocabulary, and problem-solving skills appropriate for an introduction to electricity and magnetism, optics, and modern physics. We shall focus on both basic science and its applications while discussing different empirical methods used to solve problems and make discoveries. These topics are, in a very large sense, responsible for the bulk of our 20th and 21st century technology, and we will discuss how they were historically developed. The laboratory gives hands-on experience with technologies and techniques used to measure physical quantities as well as practice using the scientific method of inquiry.

General Education Student Learning Outcomes: PHYS 2310 and 2310L are certified as General Education courses fulfilling the Natural Science with Laboratory category. The overall outcomes for the category are:

- Students will explain how scientific knowledge develops over time as new evidence emerges.
- Students will demonstrate scientific literacy by locating, evaluating, interpreting, and applying scientific information/data.
- Students will explain how scientific developments impact society.
- Students will demonstrate the connection between scientific theory and application.
- Students will apply the methods of science by testing hypotheses and reporting the results.

Required Course Materials: Textbook:

Fundamentals of Physics by Halliday and Resnick, 12th Ed. John Wiley & Sons, Inc., , 2022, ISBN: 9781119773511.

Technology Requirements for Course: You need access to a computer with a reliable internet connection to complete this course. Test your computer set up and browser for compatibility with UTC Learn at http://www.utc.edu/learn/getting-help/system-requirements.php. As there are videos with sound that you must watch, you will also need speakers or headphones. You should also have an updated version of Adobe Acrobat Reader, available free from https://get.adobe.com/reader/.

Technology Skills Required for Course: These include using Microsoft Word and Excel, using the learning management system (UTC Learn), using MOCSNet email, creating and submitting files to UTC Learn and Canvas, copying and pasting, and downloading and installing

software. As there are videos with sound that you must watch, you will also need speakers or headphones.

Campus Safety Policy: Due to COVID-19, there is a campus safety policy (https://www.utc.edu/walker-center-teaching-learning/covid-19-safety-policy.php) for classes that meet on campus; please review this policy.

UTC policies on COVID Absences

If a student is COVID-19 positive or exposed to someone who is COVID-19 positive, the student is encouraged to complete the COVID-19 Notification form and follow the recommendations provided by the UTC Health team. Documentation will be provided to the instructor by the Office of Student Outreach & Support.

Similar to any illness, verified documentation must be provided to faculty to provide reasonable accommodations for absences related to COVID-19. Instructors have considerable discretion in deciding how students may make up any coursework. Reasonable accommodations for absences related to COVID-19 are consistent with non-COVID related absences and may include but are not limited to: submission of late coursework within a reasonable amount of time, dropping the lowest grade(s), or alternate assignments. Students are encouraged to continue to participate in the course using any online assets and tools that the instructor may make available through UTCLearn. As learning objectives are often tied to institutional and program accreditation or outside partnerships, each department may have additional guidelines for student absences, as in some cases, attendance is an inseparable function of course learning objectives (e.g., clinical labs, scientific labs, material demonstrations, internships, etc.), and students must be able to complete course learning outcomes.

If COVID-19 related illness results in any missed course work (face-to-face or online), it is the responsibility of the student to contact the instructor to plan make-up work. It is recommended that students contact the instructor within 48 hours of recovering to avoid missing the opportunity to make-up necessary work. Work associated with any absence accommodations must be completed by the student according to the plan devised by the instructor. Class will continue when students are absent, and students who are absent may be unable to complete all work by the end of the semester. In such a case, students should consider a late withdrawal. Please contact the Records Office (423-425-4416) to learn more about the late withdrawal process.

If a student seeks an accommodation for a disability related to COVID-19 that may affect attendance, the student must contact the Disability Resource Center (DRC) (423-425-4006) to request disability accommodations. The DRC will evaluate requests in accordance with the university's disability accommodation process, which involves consultation with the student's instructors regarding reasonable accommodations that may be granted.

If students believe the instructor has not made reasonable and appropriate accommodations for absences due to COVID-19, students have the right to appeal according to UTC's General Student Grievance (Complaint) Procedure by filling out the Student Complaint Form and submitting to the Office of the Dean of Students.

Technology Support: If you have problems with your UTC email account or with UTC Learn (Canvas), contact IT Help Desk at 423-425-4000 or email helpdesk@utc.edu or itsolutions@utc.edu.

Student Technology: If you have technology needs to access your courses and/or complete course requirements in Canvas, submit a request (https://new.utc.edu/information-technology/learning-from-home) with Information Technology.

Student Accommodations: If you have accessibility and accommodation requests, contact the Disability Resource Center (https://www.utc.edu/disability-resource-center/index.php) at 423-425-4006 or email DRC@utc.edu

Course Assessments and Requirements: 3 tests and a final Exam and a term paper

Course Grading policy:

Three tests: 20% each; Final Exam: 30%; Term Paper: 10%.

Total score	grade 90 -- 100	A
	80 -- 89	B
	70 -- 79	C
	60 -- 69	D
	< 60	F

Instructor Grading and Feedback Response Time: 1 day

Course and Institutional Policies

Student Conduct Policy: UTC's Academic Integrity Policy is stated in the Student Handbook.

Honor Code Pledge: I pledge that I will neither give nor receive unauthorized aid on any test or assignment. I understand that plagiarism constitutes a serious instance of unauthorized aid. I further pledge that I exert every effort to ensure that the Honor Code is upheld by others and that I will actively support the establishment and continuance of a campus-wide climate of honor and integrity.

Course Participation/Contribution: The students are expected to participate all the lectures and contribute to the classroom discussion.

Course Learning Evaluation: Course evaluations are an important part of our efforts to continuously improve the learning experience at UTC. Toward the end of the semester, you will receive a link to evaluations and are expected to complete them. We value your feedback and appreciate you taking time to complete the anonymous evaluations.

UTC Bookstore: The UTC Bookstore will price match Amazon and BN.com prices of the exact textbook - same edition, ISBN, new to new format, used to used format, and used rental to used rental format, with the same rental term. For more information, go to the Bookstore Price Match Program webpage, visit the bookstore, email sm430@bncollege.com or call 423-425-2184.

Course Calendar/Schedule:

8/23, Chapter 21 Coulomb's Law;

8/25 – 9/1, Chapter 22 Electric Field;

9/6 - 8, Chapter 23 Gauss' Law;

9/13 - 15, Chapter 24 Electric Potential ;

9/20, Tuesday, First Test;

9/22 - 29, Chapter 25 Capacitance;

10/4 - 11, Chapter 26 Current and Resistance;

10/13, Thursday, Second Test;

10/17 – 18, Fall Break

10/20 - 25, Chapter 27 Circuits;

10/27 – 11/3, Chapter 28, Magnetic Fields;

11/8 - 10, Chapter 29 Magnetic Fields of currents;

11/15, Tuesday, Third Test;

11/15, Tuesday, Term paper due to be submitted by uploading files on Canvas

11/17 - 22, Chapter 30 Magnetic Induction and inductance;

11/23 – 24, Thanksgiving Holiday

11/29 – 12/1, Chapter 31 Electromagnetic Oscillations and Alternating Current;

12/6, Reading Day;

12/8, Thursday, 10:30-12:30, Final Exam.

Homework: Chapter 21: 7,11,13,39,61,65
Chapter 22: 7,9,11,15,19,23,35,39,43,45,57,59,81
Chapter 23: 1,7,31,39,45,49,73
Chapter 24: 3,5,7,9,11,13,15,17,19,21,23,25,35,37,41,47,55,5965,67,73,89,91
Chapter 25: 3,11,13,15,21,25,27,29,33,37,39,41,45,47,49,51,59
Chapter 26: 3,5,15,17,21,23,25,41,45,47,49,51,53,55,63,67,73,75
Chapter 27: 1,3,7,19,23,29,31,33,57,59,61,65,67,95
Chapter 28: 1,3,9,11,17,21,25,27,29,31,39,41,43,45,47,49,55,61,63,69,71,75,77,81
Chapter 29: 1,3,7,9,13,17,21,41,43,45,47,49,51,53,57,59,65
Chapter 30: 3,7,9,11,13,19,23,29,31,37,43,47,49,51,55,75,89
Chapter 31: 1,5,9,15,17,25,27,29,35,37,41,45,47,53,59,61,63,69,73,85,91
Chapter 32: 13,15
Chapter 33: 1,3,7,9,11,13,15,19,21,33,35,39,47,53,57,65,69,93

The Term Paper

The students are required to write a term paper as a partial fulfillment of the course, which counts 10 % of the performance in evaluation. The term paper should address some of the following issues:

- cultivate an understanding of scientific methods of thought and a broad view of scientific achievements;
- focus on theories and discoveries fundamental to the current scientific representation of reality;
- develop an historical perspective that includes the contributions of scientists to the understanding of scientific principles;
- emphasize the demand for evidence as the ultimate test of scientific validity;
- analyze the advantages and limitations of empirical approaches to understanding and influencing the world around us;
- promote an understanding of the roles of imagination and logical reasoning in the development of scientific thought;
- give appropriate attention to societal issues arising from scientific and technological developments, such as ethical dilemmas, environmental problems, and religious controversies;
- use appropriate technology to aid in the understanding of scientific principles and in the solution of problems.

Guidelines for term paper

1. The topics for term paper

It should be related to electricity and magnetism, or to the historical development of electric industry or theories, or the social and political implications of them.

2. Length and typographical requirements

The main text typed in plain Times New Roman font 12 should be at least 4 pages, not including figures, footnotes and references. More than one type of references are better than a single type of references such as articles from the websites only. All the references should be cited in the main text and a list of references should be appended at end of the paper. Each reference include the title and the author of the paper, name of magazine and year of publication, volume and page numbers, or website address. All the quoted texts need to be put in the quotation marks. You are encouraged to discuss the subject with your own idea and language, and discouraged to construct a paper by simply using copy-and-paste technique.

3. Structure and format of the paper

A scientific term paper need to include but not limited to the following parts:

1. Introduction and historical background of the subject under discussion. This part explains why the issue or subject is important, how was it developed, and what are the current situation about the issue.

2. Analysis of the issue. In this part the different aspects of the issue are fully explored and analyzed quantitatively, supported with figures, charts and tables. Controversy is analyzed and your opinion and solutions are fully explained. Depending on the nature of topics, this part is the most dynamic and may be organized and presented in vary different way. It is up to your knowledge and skill to present a strong case with a convincing analysis.

3. Conclusion. The last but not the least important part of your paper is the conclusion. You need to offer a concise summary of what conclusions you can draw from your discussion and analysis. What are the problems related to the issue at the present, and what are the possible solutions to these problems.

Syllabus of Physics 2310 Lab

Fall 2022, August 22 – December 5, 2022

PHYS2310L, Section 1 CRN#40800
1 credit hour

Instructor: Mr. Steven Kline
Email: steven-kline@utc.edu

Office Hours and Location:
By appointment/email.
Course Meeting Days and Time: Tuesday 3:40 – 5:30
Location: Grote 216 and Grote 217 (20609)

Important Notice: Due to Covid-19, the above meeting time and location need to be adjusted to accommodate the students under the requirement of social distancing.

Catalog Description: Laboratory to accompany Physics 2310. Experiments investigate **v**arious aspects **o**f electromagnetism, electrical currents and instrumentation.

Course Learning Outcomes: This course is certified as a General Education course fulfilling the Natural Science (with lab component) category when taken in combination with Physics 2310. Please consult with your advisor and check the specific requirements for your major to determine if this course is a good fit for your plan of study. Upon completion of the required credit hours in this category, students will be able to:

- Explain intellectual foundations, conceptual approaches, and methodologies of the natural sciences.
- Understand and explain scientific terminology.
- Discuss historical, social and political issues related to scientific data and advances.
- Construct graphic and analytical models from a description of a specific natural phenomenon.
- Formulate a hypothesis based on empirical data.
- Apply the scientific method to solve problems.
- Design experiments to test hypotheses.
- Express conclusions and implications from scientific experiments using a variety of methods.

Course Pre/Co Requisites:
Corequisite : Physics2310 or permission of the head of the department.

Course Materials/Resources: Download the lab manual from Canvas Course Syllabus and Module

Evaluation/Assessment:
The 10 lab reports and the final exam make 11 equal units. The lowest grade of the 11 units will be dropped. The remaining 10 units will be averaged to determine the grades.

Grading Scale:
A≥90%; B=80---89%; C=70---79%; D=60---69%; F<60%

Lab Report Deadlines, Formats, and Grading:
Each student will submit written lab reports electronically by uploading your files on Canvas Assignments. The report is due one week after the experiment. A 20% discount of score points will be imposed on lab reports late by a week.

If we find that two students copied their lab reports from each other (directly or paraphrased), neither student will receive credit for the lab report.

Do not copy and paste the contents in the instruction file. Rewrite the theory and procedure parts of your lab reports in your own language. Copy and paste practice is deemed plagiarism.

If we find that unauthorized aid is being used from current or past students, the reports will receive a grade of zero. Since aiding is an equal violation of the honor code to receiving aid, all students involved will receive zeros for their reports. Serious violations of the university's honor code (outlined in the UTC Student Handbook) could result in appearing in honor court and failing the course.

Specific Assessment Guidelines:
The lab reports must contain the following parts:

1. Title of the experiment, name of the student, Name of the partner, date. (5 points)
2. Equipment and experimental set-up (including sketch of set-up and diagram). (5 points)
   Include a diagram of the experimental set-up here.
3. Theory (including formula and equations). (10 points)
   Do not copy and paste the theory part from the lab instruction file. Use your own words to rewrite the theory. Rewriting is a process of digestion. Your rewriting will not make sense if you have not understood the material. Copy-and-paste practice does not help you to understand the theory. Be sure to include the necessary formula and equations here. It does not have to be very long. 2-3 paragraphs should be sufficient.
4. Procedure: a brief description of steps to carry out the experiment. (10 points)
   Again, do not copy and paste the procedure from the lab instruction file. Use your own words to rewrite the procedure. This part does not have to be very long and tedious. Just briefly describe the steps of the experiment.
5. Data analysis, including the raw data, organized data table, graphs, figures, plots, calculations, error analysis, and sample calculation. (50 points)
   This is the main body of the experiment, and it is your own work. You must give a sample calculation to show that you do understand the theory and procedure, but do not show the repeated calculations which will make the report unnecessarily long. Just list the results of these repeated calculations.
6. Conclusion: This part is where you report your final experimental results with error margin, comment on the results as compared to the theory, a brief description of the error sources, and the possible ways to improve the experiment. (20 points)
7. You are expected to have downloaded the instruction file and have read it before coming to the lab, so that you are coming prepared. Pre-read the instruction prepares you to understand the theory and procedures clearly, and your performance will be efficient. It is a way to assure you finish the experiment in time.
8. All lab reports must be printed submitted as hard copies. No electronic version will be accepted.
9. Keep the lab reports till the end of the semester. You will need them in the final exam. It is also important that you have the evidence that you have attended the labs and submitted the reports with grades, in case some technical problems might happen to the records.

Accommodation Statement:
If you are a student with a disability (e.g. physical, learning, psychiatric, vision, hearing, etc.) and think that you might need special assistance or a special accommodation in this class or any other class, call the Disability Resource Center (DRC) at 425—4006 or come by the office, 102 Frist Hall. You can also contact the Disability Resource Center (https://www.utc.edu/disability-resource-center/index.php) or email DRC@utc.edu

Counseling Center Statement:
If you find that personal problems, career indecision, study and time management difficulties, etc. are adversely affecting your successful progress at UTC, please contact the Counseling and Career Planning Center at 425--4438.

UTC Bookstore: The UTC Bookstore will price match Amazon and BN.com prices of the exact textbook - same edition, ISBN, new to new format, used to used format, and used rental to used rental format, with the same rental term. For more information, go to the Bookstore Price Match Program webpage, visit the bookstore, email sm430@bncollege.com or call 423-425-2184.

Campus Safety Policy: Due to COVID-19, there is a campus safety policy (https://www.utc.edu/walker-center-teaching-learning/covid-19-safety-policy.php) for classes that meet on campus; please review this policy.

COVID-19 Absence Policy: Due to COVID-19, there is an absence policy (https://www.utc.edu/walker-center-teaching-learning/covid-19-absence-policy.php).

Technology Support: If you have problems with your UTC email account or with UTC Learn (Canvas), contact IT Help Desk at 423-425-4000 or email helpdesk@utc.edu or itsolutions@utc.edu.
Student Technology: If you have technology needs to access your courses and/or complete course requirements in Canvas, submit a request (https://new.utc.edu/information-technology/learning-from-home) with Information Technology.

SCHEDULE OF EXPERIMENTS

8/23 – No Lab
8/30 – Lab 1: DC circuits and Ohm's Law
9/6 – Lab 2: Temperature dependence of resistance
9/13 – Lab 3: The Wheatstone Bridge and Resistivity
9/20 – Lab 4: Oscilloscope
9/27 – Lab 5: RC Circuits
10/4 – Lab 6: I-V Curves
10/11 – Lab 7: Diode power supply
10/18 – Fall Break
10/25 – Lab 8: Magnetic Fields and Induction
11/1 – Lab 9: AC Reactance
11/8 – Lab 10: LRC Resonance
11/15 – Make-up lab
11/22 Final Exam

*Everything on this syllabus is subject to changes at the discretion of the instructors. In case of class cancellation by the University, the schedule will be modified. It is the responsibility of the student to keep up with changes announced in class, by email, or at UTC Learn.

Lab Rules

1. Missing test or lab: If a student cannot take a test or lab at the scheduled time, he or she should notify the instructor at least 24 hours in advance, or, in case of emergency, a copy of the police report or registration record from a hospital emergency room is required for arranging a make-up test. There will be no more than two make-up labs. An unexcused lab could be used as the one of lowest grade (zero) and be dropped.
2. Pay attention to the safety of your classmates and yourself.
3. The students are expected to come to the lab prepared and have read the manual beforehand.
4. Each student should have their own lab reports although they may share the experimental data.
5. Do not play with the equipment before instructed.
6. Leave a note on equipment that is malfunctioning, stating what is wrong with it.
7. Do not move equipment from one table to another.
8. Clean up afterward and place equipment where you found it.
9. No food or drink in the lab.
10. Pick up the trash on the floor and tables. Throw trash into the trash can. Do not throw any solid object into any sink.

Principles of Physics – Optics and Modern Physics

Spring 2020
PHYSICS 2320, CRN# 20288, 3 credit hours

Instructor: Dr. Tatiana Allen, UC Foundation Professor of Physics.
Phone and Email: 423-425-4520; Tatiana-Allen@utc.edu *Email is the best way to contact me. Inquiries will be replied to as soon as possible, usually within 24 hours on work days.*
Office Hours and Location: T R 12:05-1:00 p.m., **or by appointment**; Grote 202
Course Meeting Days, Time, and Location: T R 10:50 a.m.-12:05 p.m.; Grote 103
FINAL EXAM: Tuesday 4/28, 10:30 a.m. – 12:30 p.m.

CATALOG DESCRIPTION: Calculus-based survey of principles of optics, and of the early conceptual advances in 20th-century physics: the Bohr atom, quantum theory, relativity, nuclear physics and elementary particles.

PREREQUISITES AND CO-REQUISITES: Prerequisites: ENGR 1030 and ENGR 1040, or PHYS 1030/PHYS 1030L and PHYS 1040/PHYS 1040L, or PHYS 2300/PHYS 2300L; MATH 1910/MATH 1911, MATH 1920 or MATH 1960, all with minimum grades of C, or department head approval. Co-requisite: PHYS 2320L laboratory or department head approval.

COURSE STUDENT LEARNING OUTCOMES:

- Develop a conceptual understanding, vocabulary, and calculus-based problem-solving skills in application to optics, relativity and modern physics.
- Understand how technological developments led to formation of new physics theories, which in turn provided basis for new technological advances.
- Apply conservation principles, and the connection between these concepts and various subfields of physics.
- Gain an appreciation for how physical principles affect our daily lives.

REQUIRED MATERIALS AND LEARNING AIDS:

Text: We will be using "*Fundamentals of Physics*", 11th Edition (previously sold as 10th ed), by Halliday, Resnick, and Walker. We shall concentrate on selected topics in Chapters 33-42. Access to the text and other materials can be found online at http://www.wileyplus.com. This website is required for the course, as many assignments will be performed and submitted online at the WileyPlus site. How to sign up for this web site is explained in the attached student flyer.

An on-line "e-book" is included in your WileyPlus account. However, it is strongly encouraged to have a hard copy of the book for your reference (an older edition will work fine). The Student Study Guide and Student Solutions Manual are also available and recommended as a useful aid in problem solving.

UTC Learn (CANVAS): Access the system with your UTC student ID. Additional course materials and announcements will be posted here for which you will be responsible. Check it often.

***Scientific* Calculator**: You must own one and bring it with you to class. You should familiarize yourself with how to use scientific notation and trigonometric functions on it. Note that calculators on cell phones and other personal electronic devices are not permitted in class.

SUPPLEMENTAL/OPTIONAL COURSE MATERIALS:
There are some printed materials **that include several study guides and a sample test bank** that I put on reserve at the UTC Lupton Library. The materials are available at the circulation desk at the Library (ask for Physics 2300 materials).

TECHNOLOGY

- **Technology Requirements for Course:** *access to a computer with Internet connection is required. Such computers are available at UTC library.*
- **Technology Skills Required for Course:** *Technology Skills required to successfully complete the course are being able to use email, UTC Learn, and web applications.*
- **Technology Support:** *If you have problems with your UTC email account or with UTC Learn, contact the IT Solutions Center at 423-425-4000 or itsolutions@utc.edu.*

Communication: All items in this syllabus are tentative. Class announcements will be made through UTC Learn, email, and in class. Please check your UTC email and UTC Learn on a regular basis. **It is the responsibility of the student to keep informed of any changes made in assignments, exam and/or homework due dates, or changes in the course format itself, new materials, missed content. Students are also responsible for all information given in class.**

COURSE GRADING POLICY: the tentative grading plan will be as follows:

Weekly Work (Wiley Plus): (One assignment in each category will be dropped):	16%
Exams (4, drop 1) @ 18% each:	54%
Final exam (comprehensive):	30%
Total	**100%**

Grading Scale and Feedback Response Time:

90-100% = A; 80-89% = B; 70-79% = C, 60-69% = D; <60% = F.

Final grades will be rounded precisely. If you have an 89.4% final average, this is a B. If you have a 69.5%, this is a C. UTC does not use +/- grades. The grades for each assignment will be posted on the UTC Learn as soon as the assignment is graded (usually within 10 days). Grade-related questions will be accepted within one (1) week of the grade posting only in person (not by e-mail).

COURSE AND INSTITUTIONAL POLICIES:
Weekly Work: This course is organized in 4 parts. Each part covers 2-3 chapters. At the end of each part there is an exam. For each chapter, you will be given a set of SLOs (Student Learning Objectives) which is your roadmap/study guide for the given topic. For each chapter you will have assigned materials ***to review before class***. The textbook is assigned as ***required reading*** because it provides important background information for you to be able to understand and apply the content. You will also find "***Pre-lecture Videos***" for each topic on WileyPlus. These need to be reviewed before the first lecture on a given topic. You are encouraged to take notes while you read the book or view the videos.

There will be assigned ***work on WileyPlus***. The problems will have different sets of numbers for each student. WileyPlus work will need to be submitted though your WileyPlus account. **There are no late**

submissions or make-up opportunities on Weekly Work, however, the lowest grade in each category of Weekly Work will be dropped.

Attendance Policy/ Course Participation/Contribution: Attendance in lecture is **required**. If you have an emergency, please notify me by e-mail at your earliest convenience and provide verification documents. You grade will be dropped one letter grade for every 3 (three) unexcused absences. You are expected to complete all scheduled activities. This is a three credits course, so you should expect to spend 6-9 hours per week on this course outside of classroom.

Course Deadlines: Each assignment will have a posted delaine. *It is your responsibility to plan ahead so that your work is turned in on time.* Work that is submitted online will receive credit only if submitted on time: this means that your work should be submitted prior to the posted time and date. Information submitted **after** the posted time will be refused by the server, even if the time at which you logged onto the server was prior to the deadline (!).

Late/Make-Up Work Policy: Late work is not accepted on Weekly Work assignments. Late **Exams** may only be retaken due to (a) illness (a doctor's excuse is required), or (b) a family emergency (verification will be requested). Make-up exams must be scheduled within 3 days of the student's return to classes. Make-up exams are equal to or exceed the original exam in difficulty. The "Missed assignment form" is available for download from the UTC Learn. **All make-up work (done with prior approval of the instructor) or work for extra credit must be turned in by the last day of class, Thursday, April 16th-- no exceptions! No extra credit work (other than that announced in class) may be done to substitute for low grades or missed homework, quizzes, or exams. No exceptions.**

Student Conduct Policy: UTC's Academic Integrity Policy is stated in the Student Handbook (https://www.utc.edu/dean-students/student-handbook.php).

Honor Code Pledge: I pledge that I will neither give nor receive unauthorized aid on any test or assignment. I understand that plagiarism constitutes a serious instance of unauthorized aid. I further pledge that I exert every effort to ensure that the Honor Code is upheld by others and that I will actively support the establishment and continuance of a campus-wide climate of honor and integrity.

Course Learning Evaluation: Course evaluations are an important part of our efforts to continuously improve learning experiences at UTC. Toward the end of the semester, you will be emailed links to course evaluations and you are expected to complete them. We value your feedback and appreciate you taking time to complete the anonymous evaluations.

UTC Bookstore: The UTC Bookstore will price match Amazon and BN.com prices of the exact textbook - same edition, ISBN, new to new format, used to used format, and used rental to used rental format, with the same rental term. For more information, go to the Bookstore Price Match Program webpage, visit the bookstore, email sm430@bncollege.com or call 423-425-2184.

Finally.....

Please know that I am here to help you. Also, remember that "struggling" with an assignment is, more often than not, a necessary part of improving your knowledge and skills as you learn to "speak the language", rather than a sign of ineptitude. Believe in yourself! This is a difficult material, but thousands of people master it every year! You can do it too!!!!!

Schedule (tentative, the dates can change; the announcements will be made in class)

Class	Date	Day	Class	Assessment
1	1/7	Tu	Syllabus, WileyPlus, Ch 33	
2	1/9	Th	Ch 33	
3	1/14	Tu	Ch 33	
4	1/16	Th	No class, CUWiP travel	
5	1/21	Tu	Ch 34	
6	1/23	Th	Ch 34	
7	1/28	Tu		**Exam 1 (Ch 33, 34)**
8	1/30	Th	Ch 35	
9	2/4	Tu	Ch 35	
10	2/6	Th	Ch 35, 36	
11	2/11	Tu	Ch 36	
12	2/13	Th	Ch 36	
13	2/18	Tu		**Exam 2 (Ch 35, 36)**
14	2/20	Th	Ch 37	
15	2/25	Tu	Ch 37	
16	2/27	Th	Ch 38	
17	3/3	Tu	No lecture. Field trip to a Medical Physics Facility. The date and time of the field trip will depend on the schedule of the facility and will be announced separately.	
18	3/5	Th	No lecture. Field trip to the TVA Central Labs. The date and time of the field trip will depend on the schedule of the facility and will be announced separately.	
	3/10, 3/12	Tu, Th	**Spring break**	
	3/16	Mon	**Last day to withdraw from the class with a W**	
19	3/17	Tu	Ch 38	
20	3/19	Th	Ch 38	

21	3/24	Tu		**Exam 3 (Ch 37-38)**
22	3/26	Th	Ch 39	
23	3/31	Tu	Ch 39	
24	4/2	Th	Ch 40	
25	4/7	Tu	Ch 40	
26	4/9	Th	Ch 41	
27	4/14	Tu	Ch 41	
28	4/16	Th		**Exam 4 (Ch 39-41)**
	4/28	**Tuesday**	**Final exam 10:30 a.m.-12:30 p.m.**	

The University of Tennessee at Chattanooga

Principles of Physics –Optics and Modern Physics Laboratory

Spring 2020

Physics, 2320L, CRN 20291, face to face, 1 credit hour

Instructor: Dr. Luis E. Sanchez Diaz

Email and Phone Number: luis-sanchezdiaz@utc.edu and (423) 425-4546

Office Hours and Location: Monday 11:00 AM – 1:00 PM, Tuesday and Thursday 12:05 AM – 1:50 PM, and in Grote Hall room 203. If you cannot attend my office hours, please email me with your questions any time; I will respond within 24 hours. Phone and virtual appointments are available as needed.

Course Meeting Days, Times, and Location: Wednesday, 1:00 – 2:50 PM (Official), in Grote 214. Please check the schedule below on the last page. You have a week to perform the lab and submit your lab report.

Course Catalog Description: Laboratory to accompany Physics 2320. Experiments investigate geometrical optics, interference, diffraction, and radioactivity, with emphasis given to error analysis. Every semester. Two hours per week. Corequisite: PHYS 2320 or department head approval. Laboratory/studio course fee will be assessed.
1.000 Credit hours 1.000 Lab hours

Course Pre/Co Requisites: *Corequisite*: PHYS 2320 or department head approval.

Course Student Learning Outcomes: Upon completion of the required credit hour in this category, students will be able to:

- Explain some of the basic experimental methods used to investigate optics and modern physics.
- Understand and explain the scientific terminology concerning optics and modern physics.
- Construct graphic and analytical models relating to optics and atomic structure.

- Practice detailed observation and recording of real data in experiments.
- Integrate conceptual ideas with practical quantitative laboratory activities.
- Express conclusions and implications from scientific experiments using a variety of methods.
- Develop and enhance skills pertaining to writing valid scientific reports.

General Education Statement: Physics 2320 and 2320L are certified as General Education courses fulfilling 4 hours in the Natural Science Laboratory (SL) category. Please consult with your advisor and check the specific requirements for your major to determine if this course is a good fit for your plan of study.

Required Course Materials: A. Laboratory Manual: A description of all experiments as well as the report cover and data pages are available for printing from the class website at UTC Learn. You must print pre-lab and data pages for each experiment and bring them to class with you. Printers in the laboratory are not for printing the report pages, they are reserved for printing data generated in the lab. Please make sure that you print the pages with one page per sheet of paper. The schedule lists which experiment you will need for a given week. **B. *Scientific* Calculator**: You need to own one and bring it to lab. It need not be a graphing calculator, but should be able to perform calculations like the logarithm of a number, exponents, trigonometry, and work in scientific notation. You should familiarize yourself with how to use scientific notation and trigonometric functions on it. Calculators on cell phones and other personal electronic devices are not permitted

Technology Requirements for Course: You need access to a computer with a reliable internet connection to complete this course. Test your computer set up and browser for compatibility with UTC Learn at http://www.utc.edu/learn/getting-help/system-requirements.php. As there are videos with sound that you must watch, you will also need speakers or headphones. You should also have an updated version of Adobe Acrobat Reader, available free from https://get.adobe.com/reader/.

Technology Skills Required for Course: These include using Microsoft Word and Excel, using the learning management system (UTC Learn), using MOCSNet email, creating and submitting files to UTC Learn, copying and pasting, and downloading and installing software. As there are videos with sound that you must watch, you will also need speakers or headphones

Technology Support: If you have problems with your UTC email account or with UTC Learn, contact IT Solutions Center at 423-425-4000 or email itsolutions@utc.edu.

Course Assessments and Requirements: The purposes of the final grade are (1) to define and communicate the student's level of educational achievement and (2) to motivate students to greater effort. The table below summarizes the components of this course that contribute to a student's final grade. Sections A and B give more detail about each component.

	Percentage
Lab Reports (best 10 of 11)	75%
Final Exam	25%
Total	*100%*

A. Lab Reports

Lab reports will be written for each experiment. The best 10 of 11 lab assignments will compose the lab reports portion of your grade. If all 11 assignments are completed, the lowest grade will be dropped. The lab report is turned in at two different stages as follows:

1. The *hand-written* pre-lab portion of each report (including objective, relevant background, and methods) is due at the beginning of the session in which the experiment will be performed, when you walk into the laboratory. Late pre-labs are not accepted, since the intent is that you do them to prepare for the experiment. *2.* The remainder of the report (data gathered, calculations and graphs, results and discussion sections) must be completed during the ensuing week, to be handed in at the beginning of the next laboratory session. If there are any changes to this for individual labs, your instructor will announce it during the session.

The components needed for individual lab reports will be listed within the lab manual for each experiment. In general, the points will be divided as follows:

Pre-lab (goals, background, methods)	20%
Experimental data / Calculations / Graphs	50%
Analysis and Discussion of Results	25%
Style	5%

Specific Assessment Guidelines:

1. The pre-lab report pages are available for download and *must be hand-written on the provided pages.* Pre-labs may contain sections for goals, background, and experimental methods (including sketches for set ups or circuit diagrams). Study the description of the experiment in the manual carefully to get the overall idea of what you are doing, and only include *relevant* information in your pre-lab report. Theory sections are not bulleted lists of concepts or equations, and nothing on your pre-lab report should be a direct copy of all information in the manual (which would be considered plagiarism).

2. The data and calculation pages that are specific for each experiment are available for download and must be printed before you come to lab (not on the lab printers). Your data will be assessed for the quality of the work you performed. Also, neatness of reports counts, and you should take pride in your work. Use pencil on these so that you can erase if you have errors in your calculations. Calculations must be shown where indicated, and will be graded for accuracy.

3. Some discussion questions may be included on the report pages. You need to appropriately analyze your results to find the relationships between physical variables being studied in order to answer these. They are part of the analysis and discussion of results portion of your grade, and need to be written in complete sentences.

4. All required graphs for your report must have the following: Proper title; properly-labeled coordinate axes with units; clearly marked data points; an analysis/equation that best fits your data, and a

goodness of fit estimate. All graphs in this lab will be generated by appropriate computer software that is on the computers in the laboratory.

5. Generally, in the results section of the report, you will be reporting your obtained results, comparing them with known parameters, and discussing sources of errors. All results need units and should be properly rounded (having the same decimal places in the result and its uncertainty, and only one significant digit in the uncertainty.) Results should be written in the form of sentences, not a bulleted list of determined quantities. When evaluating errors, make sure that you understand the difference between experimental errors and mistakes. Experimental errors are unavoidable and can be estimated from the measurement uncertainties. They include systematic errors (possibly calibration errors in equipment) and random, statistical uncertainties that occur. Mistakes are ***not*** "experimental errors," and can be avoided by careful checking and proof-reading; *they will reduce the amount of credit given for the lab*. This section doesn't have to be long, but it needs to address the requirements and make physical sense.

6. The overall professionalism of the report (including organization, legibility, sentence structure in reporting results and in the pre-lab) will be assessed by the "Style" portion of your grade. Assemble the second portion of your report in the following order: data pages (including your name first followed by your partner), results, and graphs.

B. Final Exam

The final exam will be a written exam that is comprehensive of all labs performed in the course.

Course Grading

Course Grading Policy: 90-100% = A; 80-89% = B; 70-79% = C, 60-69% = D; <60% = F. Final grades will be rounded precisely. If you have an 89.4% final average, this is a B. If you have a 69.5%, this is a C

Instructor Grading and Feedback Response Time: I will try my best to grade all assignments within one week of the due date and provide written feedback when necessary.

Course and Institutional Policies

Late/Missing Work Policy: Click here to enter text.

Missed labs must be rescheduled at the convenience of the instructor and any lab partners who may be necessary, preferably on the lab makeup date posted in the schedule below. Keep in mind that you will have the opportunity to drop one of the labs when calculating the final grade (see the **course assessment** section above), so if you miss a lab it can be counted as the dropped

lab score. However, after gaining one unexcused lab absence, you will not have the opportunity to make up labs for future unexcused absences.

Late lab reports will **not be accepted without the instructor's prior permission.** Late labs, if accepted, will be subjected to a 20% grading penalty. Late labs ***must*** be no more than one class meeting time late. Labs from the previous week are due at the **beginning** of the next class.

Student Conduct Policy: UTC's Academic Integrity Policy is stated in the Student Handbook.

Honor Code Pledge: I pledge that I will neither give nor receive unauthorized aid on any test or assignment. I understand that plagiarism constitutes a serious instance of unauthorized aid. I further pledge that I exert every effort to ensure that the Honor Code is upheld by others and that I will actively support the establishment and continuance of a campus-wide climate of honor and integrity.

Course Attendance Policy: Attendance at all laboratory sessions is required. If you miss a session, you will get a zero for this lab. If you are late to a lab session by more than 5 minutes, you are not allowed to perform the experiment and you will get zero for this lab. If extenuating circumstances cause a student to miss a lab session, then an opportunity to make up the missed lab may possibly be granted. The student must provide verification (such as a doctor's note) and obtain the instructor's approval before making arrangements for a make-up lab. However, students may not make up more than one missed lab. Pre-labs or reports that are not turned in by the deadline are not accepted.

Course Learning Evaluation: Course evaluations are an important part of our efforts to continuously improve the learning experience at UTC. Toward the end of the semester, you will receive a link to evaluations, and you are expected to complete them. We value your feedback and appreciate you taking time to complete the anonymous evaluations.

Course Calendar/Schedule: Click here to enter text.

SCHEDULE OF EXPERIMENTS – Spring 2020

Course Calendar/Schedule:

Experiment Title	**Planned Date**	**Due Date**
No class	**01/06-01/10**	
1. Data Analysis and Appendices	01/13-01/17	01/21

Holiday 01/20

2. Refraction and Reflection	01/21-01/24	01/27
3. Image formation for thin lenses	01/27-01/31	02/03
4. Intensity and Polarization of light	02/03-02/07	02/10
5. The Michelson interferometer	02/10-02/14	02/17
6. Interference and diffraction	02/17-02/21	02/24
7. Prob. distributions/particle detection	02/24-02/28	03/02
8. Atomic spectra and energy quantization	03/02-03/06	03/16

Spring Break 03/09-03/13

9. Shielding of ionizing radiation	03/16-03/20	03/23
10. Half-life and decay of nuclei	03/23-03/27	03/30
11. No class	**03/30-04/03**	
12. Final Exam	04/06-04/10	
13. No class	**04/13-04/17**	

Student Ethics in Laboratory: Although you may work with a lab partner during the experiment, lab reports should be written individually as it is important your assignment be completed with your thoughts alone. It is important that if you need help or assistance, you seek it out from fellow students or the instructor in order to get the most understanding of the concept or assignment. However, **if we find that two students copied their lab reports from each other (directly or paraphrased), neither student will receive credit for the lab report.** The results section and questions within report pages must necessarily be in your own words and with your own interpretation. **If we find that unauthorized aid is being used from current or past students, the reports will receive a grade of zero**. Since aiding is an equal violation of the honor code to receiving aid, all students involved will receive zeros for their reports. Serious violations of the university's honor code (outlined in the UTC Student Handbook) could result in appearing in honor court and failing the course. This instructor cannot and will not tolerate academic dishonesty.

Honor Code Pledge: I pledge that I will neither give nor receive unauthorized aid on any test or assignment. I understand that plagiarism constitutes a serious instance of unauthorized aid. I further

pledge that I exert every effort to ensure that the Honor Code is upheld by others and that I will actively support the establishment and continuance of a campus-wide climate of honor and integrity.

Please Note: Everything on this syllabus is subject to changes at the discretion of the instructor. In case of class cancellation by the University, the schedule will be modified. It is the responsibility of the student to keep up with changes announced in class, by email, or at UTC Learn.

Physics 3410 001 and 500, Classical Mechanics, CRN44276

Fall 2022 Syllabus (4 Credit hrs)

Instructor: Ling Jun Wang, Grote 204, Phone: 425-5248, //www.utc.edu/~lwang/
Textbook: *Classical Mechanics* by Kibble, 5th Edition. ISBN 1860944353.
Pre-requisite: Physics 230/280, 231-281 or 103/183, 104/184,
Co-requisite: Math 245 and 255.
Class meets: MW. 2:00-3:15 in Grote 103.
Phys 3410L 500 CRN#44277 meets Thursday 1:40 – 3:30 in Grote 213.
Office hours: Mon. & Tue. 3:20 – 4:20,
Wed. 9:00 – 11:00, 1:00 – 2:00, 3:20 – 4:00,
Grote 204

Objective: Dynamics of particles and continuous media; Newton's law of motion, conservation laws, generalized coordinates, Langrange's equations, and the principle of least action; the mechanics of continuous media, wave motion, sound, hydrostatics, rotational and irrotational flow, the equation of continuity, Laplace's equation.

Schedule:

8/22 - 24 Chapter 2, Linear Motion
8/29 - 31 Chapter 3, Energy and Angular momentum
9/5 Labor Day
9/7 - 12 Chapter 4, Central Conservative Force
9/14, Wed First Exam
9/19 - 28 Chapter 5, Rotating Frames
10/3 - 10 Chapter 6, Potential Energy
10/12, Wed Second Test
10/17 - 18 Fall Break
10/19 - 24 Chapter 7, Two-Body Problem
10/26 – 31 Chapter 8, Many-Body System
11/2, Wed **Third Exam**
11/7 - 21 Chapter 9, Rigid Bodies
11/23 - 24 Thanksgiving Holiday
11/28 – 12/5 Chapter 10, Lagrangian Mechanics
11/30 Reading Day
December 12, Monday, 1:00 – 3:00 pm, Final Exam (Comprehensive)

Grading Policy:

Three Tests @ 22% =	66%
Final Exam	34%

Course grade is assigned as follows:

90-100	80-90	70-80	60-70	<60
A	B	C	D	F

Student Conduct Policy: UTC's Academic Integrity Policy is stated in the Student Handbook (https://www.utc.edu/dean-students/student-handbook.php).

Honor Code Pledge: I pledge that I will neither give nor receive unauthorized aid on any test or assignment. I understand that plagiarism constitutes a serious instance of unauthorized aid. I further pledge that I exert every effort to ensure that the Honor Code is upheld by others and that I will actively support the establishment and continuance of a campus-wide climate of honor and integrity.

Attendance: The students are expected to attend the class regularly. There will be a penalty of 1 point on the semester average score for every unexcused absence (out of 100 points total). Habitual absence (25% or more) will be grounds for an F grade for the course.

Missing a test: If a student can not take a test at the scheduled time, he or she should notify the instructor and get approval for a make-up at least 24 hours in advance. In case of emergency, a copy of a police report, a registration record from a hospital emergency room, etc., is required for arranging a make-up test. There shall be no more than one make-up test for a student.

ADA Statement: If you are a student with a disability (e.g. physical, learning, vision, hearing, etc.) and think that you might need special assistance or a special accommodation in this class or any other class, call the Disability Resource Center (DRC) at 425-4006 or come by the office - 102 Frist Hall.

UTC Bookstore: The UTC Bookstore will price match Amazon and BN.com prices of the exact textbook - same edition, ISBN, new to new format, used to used format, and used rental to used rental format, with the same rental term. For more information, go to the Bookstore Price Match Program webpage, visit the bookstore, email sm430@bncollege.com or call 423-425-2184.

Homework assignment:

Chpt.1: 1,2,4,5,6,7
chpt.2: 1,3,5,7,11,13,17
chpt.3: 1,2,5,11,19,22
chpt.4: 1,2,3,4,5,6,7,8,9,10,16,28
chpt.5: 1,2,4,6,7,9,13
chpt.6: 1,3,5,7,14,16,17,18,21,22
chpt.7: 1,2,3,4,6,9,10,16
chpt.8: 1,2,3,7*,9
chpt.9: 1.2.8.9
chpt.10: 2,3,4,5,8

Syllabus of Physics 3420, Electricity and Magnetism

Spring 2022, January 10, Monday to May 3, Tuesday, 2022

Department of Chemistry and Physics, Phys 3420, Section 0, CRN#24258, 4 credit hours

Instructor: Ling Jun Wang, Grote 204
Email and phone number: //www.utc.edu/~lwang/, Phone: 425-5248
Office hours and location:
Tue. and Thur.: 11:00 – 12:00
Wednesday: 9:00 – 12:00; 1:00 - 4:00
In Grote 204

Course Meeting Days, Times and Location: Tue. Thur. 9:25-10:40, Grote 319

Recitation (P3420L) meets: Thur. 1:40 – 3:30 in Grote 213 CRN#24259

Course Pre/Co Requisites: Physics 3410, Math 245 and 255.

Course Catalog Description: A study of basic laws of electromagnetism, electric and magnetic properties of materials, Maxwell's equations, boundary value problems, electromagnetic waves.

Course Student Learning Outcomes:

1. Identify and understand the fundamental scientific laws in the scientific issues which have been presented in class. These laws provide a sound science background on the issues or projects involved.
2. Cultivate an understanding of scientific methods of thought and a broad view of scientific achievements.
3. Understand the importance of advanced technologies to industry and the U.S. economy, and to aid in the understanding of scientific principles and in the solution of problems.
4. Calculate the fundamental relationships involved in the scientific issues studied, such as the basic laws of electromagnetism, electric and magnetic properties of materials, Maxwell's equations, boundary value problems, electromagnetic waves.

Required Course Materials: Textbook: *Introduction to Electrodynamics* by David J. Griffiths, Pearson, 2013, ISBN 10: 0-321-85656-2, ISBN 13: 978-0-321-85656-2.

Course Assessments and Requirements: 3 tests and a final exam
Course Grading Policy: Three tests: 22% each; Final Exam: 34%

Average semester score	Grade
90 – 100	A
80 – 89	B
70 – 79	C
60 – 69	D
<60	F

Instructor Feedback Response Time: 1 day

Course and institutional Policies:

Attendance: The students are expected to attend the class regularly. There will be a penalty of 1 point on the semester average score for every unexcused absence (out of 100 points total). Habitual absence (25% or more) will be grounds for an F grade for the course.

Missing a test: If a student cannot take a test at the scheduled time, he or she should notify the instructor and get approval for a make-up at least 24 hours in advance. In case of emergency, a copy of a police report, a registration record from a hospital emergency room, etc., is required for arranging a make-up test. There shall be no more than one make-up test for a student.

Honor Code Pledge: I pledge that I will neither give nor receive unauthorized aid on any test or assignment. I understand that plagiarism constitutes a serious instance of unauthorized aid. I further pledge that I exert every effort to ensure that the Honor Code is upheld by others and that I will actively support the establishment and continuance of a campus-wide climate of honor and integrity.

ADA Statement: If you are a student with a disability (e.g. physical, learning, vision, hearing, etc.) and think that you might need special assistance or a special accommodation in this class or any other class, call the Disability Resource Center (DRC) at 425-4006 or come by the office - 102 Frist Hall.

UTC policies of COVID Absences

If a student is COVID-19 positive or exposed to someone who is COVID-19 positive, the student is encouraged to complete the COVID-19 Notification form and follow the recommendations provided by the UTC Health team. Documentation will be provided to the instructor by the Office of Student Outreach & Support.

Similar to any illness, verified documentation must be provided to faculty to provide reasonable accommodations for absences related to COVID-19. Instructors have considerable discretion in deciding how students may make up any coursework. Reasonable accommodations for absences related to COVID-19 are consistent with non-COVID related absences and may include but are not limited to: submission of late coursework within a reasonable amount of time, dropping the lowest grade(s), or alternate assignments. Students are encouraged to continue to participate in the course using any online assets and tools that the instructor may make available through UTCLearn. As learning objectives are often tied to institutional and program accreditation or outside partnerships, each department may have additional guidelines for student absences, as in some cases, attendance is an inseparable function of course learning objectives (e.g., clinical labs, scientific labs, material demonstrations, internships, etc.), and students must be able to complete course learning outcomes.

If COVID-19 related illness results in any missed course work (face-to-face or online), it is the responsibility of the student to contact the instructor to plan make-up work. It is recommended that students contact the instructor within 48 hours of recovering to avoid missing the opportunity to make-up necessary work. Work associated with any absence accommodations

must be completed by the student according to the plan devised by the instructor. Class will continue when students are absent, and students who are absent may be unable to complete all work by the end of the semester. In such a case, students should consider a late withdrawal. Please contact the Records Office (423-425-4416) to learn more about the late withdrawal process.

If a student seeks an accommodation for a disability related to COVID-19 that may affect attendance, the student must contact the Disability Resource Center (DRC) (423-425-4006) to request disability accommodations. The DRC will evaluate requests in accordance with the university's disability accommodation process, which involves consultation with the student's instructors regarding reasonable accommodations that may be granted.
If students believe the instructor has not made reasonable and appropriate accommodations for absences due to COVID-19, students have the right to appeal according to UTC's General Student Grievance (Complaint) Procedure by filling out the Student Complaint Form and submitting to the Office of the Dean of Students.

Schedule:

1/11 – 1/13	Chapter 1, Vector Analysis
1/18 – 1/25	Chapter 2, Electrostatics
1/27 – 2/1	Chapter 3, Potentials
2/3	**First Exam**
2/8 – 2/15	Chapter 5, Magnetostatics
2/17 – 3/1	Chapter 7, Electrodynamics
3/3 – 3/8	Chapter 8, Conservation Laws
3/10	**Second Test**
3/14 – 3/19	**Spring Break**
3/22 – 4/5	Chapter 9, Electromagnetic waves
4/7	**Third Exam**
4/12 – 4/21	Chapter 10, Potentials and Fields
4/26	**Reading Day**

4/28 (Thur.), 8:00 p.m.-10:00 a.m., **Final Exam** (Comprehensive)

Homework assignment:

Chpt.1: 1.2, 1.5, 1.11, 1.13, 1.15, 1.18, 1.21, 1.22, 1.27, 1.28, 1.29, 1.37, 1.40, 1.43, 1.63
chpt.2: 2.2, 2.5, 2.7, 2.8, 2.11, 2.12, 2.13, 2.20, 2.21, 2.25, 2.31, 2.43, 2.46, 2.50
chpt.3: 3.7, 3.13, 3.15, 3.16, 3.17, 3.18,3.19, 3.22, 3.23, 3.28, 3.29, 3.33, 3.36, 3.42, 3.57
chpt.5: 5.1, 5.3, 5.4, 5.8, 5.9, 5.13, 5.14, 5.16, 5.20, 5.23, 5.24, 5.28, 5.37, 5.41, 5.47, 5.51, 5.58
chpt.7: 7.2, 7.5, 7.7, 7.8, 7.10, 7.12, 7.13, 7.17, 7.18, 7.23, 7.24, 7.26, 7.27, 7.29, 7.31
chpt.8: 8.1, 8.4, 8.6, 8.7, 8.8, 8.9, 8.13, 8.14, 8.17, 8.22
chpt.9: 9.2, 9.3, 9.10, 9.14, 9.27, 9.29, 9.32, 9.35, 9.37, 9.38
chpt. 10: 10.1, 10.2, 10.9, 10.12, 10.14

The University of Tennessee at Chattanooga

Methods of Experimental Physics I

Fall 2022

PHYS 3980, CRN 45157, Face-to-Face, 3 Credit Hours

Instructor: Dr. Josh Hamblen

Email and Phone Number: Joshua-Hamblen@utc.edu, (423)425-5392

Office Hours and Location: Tue 11-12, Thu 11-12, Fri 11-12 Grote 205
(You're welcome to schedule an alternate meeting time with me as well.)

Course Meeting Days, Times, and Location: Fri 12:15 – 4:05 PM, GROT 103

Course Catalog Description: Experimental methods based on classical physics experiments, selected from such topics as harmonic motion, gravitation, measurement of thermodynamic properties, electrical and magnetic measurements, optics, thermodynamics, and materials science. Lecture 1.5 hours, laboratory 3 hours.

Course Pre/Co Requisites: Prerequisites: PHYS 2310 and PHYS 2310L and PHYS 2320 and PHYS 2320L, or PHYS 1040 and PHYS 1040L; and MATH 2450; or department head approval. Corequisites: PHYS 3410, or Prerequisite: PHYS 3410, or department head approval.

Course Student Learning Outcomes: The main focus of this methods course will be on studying a number of advanced undergraduate experiments in mechanics, electricity and magnetism, and optics. Students will be asked to think independently and analyze experimental results carefully, especially in their treatment of experimental errors. Students will learn how to use some of the most important standard physical models and become familiar with specialized instrumentation in the areas mentioned.

Course Fees: Laboratory/studio course fee will be assessed.

Required Course Materials:
(1) Experiments for Physics 3980 Methods of Experimental Physics I (to be downloaded from course UTC Learn website).
(2) The Uncertainty in Physical Measurements: An Introduction to Data Analysis in the Physics Laboratory by P. Fornasini, Springer Publishing, 2008. This textbook is free to access and download through the UTC Library at this link. There will be required readings and homework assigned from it.

Supplemental/Optional Course Materials: Another useful textbook reference is Experimentation: An Introduction to Measurement Theory and Experiment Design by Baird. It is free to read and download through Google Books at this link.

Technology Requirements for Course: access to a computer (such as those found in the physics computer labs) and a scientific calculator

Technology Skills Required for Course: be able to use email, UTC Learn, word processing software, spreadsheets, LoggerPro, Graphical Analysis (all available on physics lab computers)

Course Assessments and Requirements: The tentative grading weights are as follows

Laboratory Reports =	65%
Final Exam =	20
Homework =	15
	100%

Course Grading

Course Grading Policy: Your grade will be determined based on your completed lab reports, end of chapter exercises, and the final exam. A guide for determining the overall course grade is: A ≥ 90 > B ≥ 80 > C ≥ 70 > D ≥ 60 > F

Instructor Grading and Feedback Response Time: Assignments will typically be returned within 1 week of being submitted. All lab reports and homework assignments will be submitted through UTC Lean (Canvas).

Course and Institutional Policies

Late/Missing Work Policy: It is the responsibility of the student to make up any missed experimental work. *Missed laboratory exercises* must be rescheduled at the convenience of the instructor. If you are unable to attend class and would like to request a rare make-up lab, you should complete the university's Academic Notification process as soon as possible.

Lab reports and homework will be accepted without penalty for **one week** after the due date; after that, they will be subject to a 20% penalty. **NO EXCEPTIONS!**

Course Attendance Policy: ***Attendance is mandatory***. Practically every experiment requires a team of students to set up apparatus, measure and record data, and analyze the results. Also, the first part of classes will consist of lecture and/or discussion in which students are expected to participate. **No lab reports in which the student was not present to take the data will be accepted.**

Course Participation/Contribution: Students are expected to attend each class, participate in discussion, be prepared for the lab, and carry out the lab.

Course Calendar/Schedule and Due Dates: A tentative schedule is as follows

Date	**Lecture Material Covered**	**Lab Performed**	**Assignment Due**
8/26	Ch. 1: Physical Quantities, Ch. 2: Measurement Units, Appendix A Presentation of Experimental Data	-	-
9/2	Ch. 3: Measuring Instruments, & Handout on Writing Scientific Reports	Simple Pendulum Experiment	-
9/9	Ch. 4 Uncertainty in Direct Measurements	Begin Coupled Pendula Expt.	**Ch. 2 & Appendix A Homework Due**
9/16	Finish Ch. 4	Finish Coupled Pendula Expt.	**Simple Pendulum Expt. Due**
9/23	Ch. 8 Uncertainty in Indirect Measurements	Intro to Computer Modeling Experiment	**Coupled Pendula Expt. Due**
9/30	Ch. 6 Distributions of Random Variables	Blood Cell Diffraction Expt.	**Ch. 4 Homework Due**
10/7	Ch. 7 Statistical Tools	Students rotate through the final 4 experiments: Lossy Collisions, Falling Tubes Experiment, Torsional Oscillator (needs 2 weeks), Cavendish Experiment (needs 2 weeks)	**Computer Modeling Expt. Due**
10/14	Ch. 9 Confidence Levels	Continue 10/7 schedule	**Ch. 8 Homework Due**
10/21	Ch. 10 Correlation of Physical Quantities	Continue 10/7 schedule	**Blood Cell Diffraction Due**

10/28	Finish Ch. 10	Continue 10/7 schedule	**Your 1st experiment from the final rotation due**
11/4	Ch. 11 The Chi Square Test	Continue 10/7 schedule	**2nd experiment from the final rotation due**
11/11	Catchup on textbook material as needed	Continue 10/7 schedule	**Ch. 10 Homework Due**
11/18	Final Exam Review	Lab makeup day if needed	**3rd experiment from the final rotation due**
11/25	No class – Thanksgiving		
12/2	**Final Exam**	No labs	**4th experiment from the final rotation due**
12/7	**Any outstanding lab reports and homework assignments must be submitted by 5 pm! No exceptions!**		

Lab Preparation: Students are responsible for watching the pre-lab videos and reading the Physics 3980 experimental notes on UTC Learn which describe the requirements of the experiment before class!!

Reading Assignments: Must be completed before class according to the schedule above

Please Note: All items in this syllabus are tentative; changes in assignments, or lab report/homework due dates may be announced in class. It is the responsibility of the student to stay abreast of any changes made in class assignments, or changes in the course format itself.

Please note the following:

a) Each student is responsible for their own report. After completion of the data-taking, you may wish to discuss your interpretation of the data with others, but you must write your own report independently. **Word-processed reports are preferred; calculations may be done by hand.**

b) Data must not be shared with others, unless specifically directed to do so by the instructor.

c) The emphasis in the reports is to be on the data and its interpretation, graphical analysis, and sources of error (which should be quantified if possible). If you feel that a problem was encountered in data-taking which caused you to make a departure from the stated experimental method, then write out the steps which you took in detail.

d) This course requires a high degree of responsibility and maturity on the part of the student: your attendance and participation is vital. Several of the experiments will require the use of outside material (which will be provided, or placed on reserve in the library) in order for you to understand the basic physics underlying the data. If you cannot make a class meeting, it is your responsibility to make up the session **at the convenience of the instructor**.

Students should feel free to discuss course material/homework with me, during my office hours or by appointment, after first trying to work things out for themselves. Please remember that I am here to help you, but I am **not** here to do the work for you!

The University of Tennessee at Chattanooga

Methods of Experimental Physics II

Fall 2023

PHYS 3990, CRN 46067, Face-to-Face, 3 credit hours

Instructor: Dr. Josh Hamblen

Email and Phone Number: (423) 425-5392, HYPERLINK "mailto:Joshua-Hamblen@utc.edu"Joshua-Hamblen@utc.edu

Office Hours and Location: Tue 11-12, Thu 11-12, Fri 11-12 (or by appt.) Grote 205

Course Meeting Days, Times, and Location: Fri. 12:15 PM – 4:05 PM, First hour of class in GROT 103, rest of class in and around GROT 226

Course Catalog Description: Experimental methods based on modern physics experiments, selected from such topics as atomic emission and absorption spectra, the Franck-Hertz experiment, the Stern-Gerlach experiment, quantum optics, electron-spin resonance, nuclear magnetic resonance, X-ray diffraction, and nuclear radiation measurements (utilizing Geiger-counters and multichannel analyzers). Lecture 1.5 hours, laboratory 3 hours.

Course Pre/Co Requisites: Prerequisites: PHYS 2310 and PHYS 2310L and PHYS 2320 and PHYS 2320L; or PHYS 1040 and PHYS 1040L; and MATH 2450; or department head approval. Corequisites: PHYS 3410, or Prerequisite: PHYS 3410, or department head approval.

Course Student Learning Outcomes: The main focus of this methods course will be on studying a number of advanced undergraduate experiments in modern physics. These experiments will ask students to think independently and analyze results carefully: treatment of experimental errors will be important. Students will learn how to use some of the most important standard physical models and become familiar with specialized instrumentation in the areas mentioned. To aid in the understanding of the development of modern physics, a number of chapters will be covered which deal specifically with the conceptual revolution in 20th century physics.

Specific student learning outcomes assessed in this course:

- Understand the need for developing new physics models when the limits of "classical" models break down, such as at very high speeds or small distance scales.
- Explore the concepts of the wave-particle duality. (Light behaving as a particle, and matter behaving as a wave.)
- Develop experiments to test these new, modern physics theories.
- Write reports to describe results of your experiments, paying attention to experimental uncertainties.

Course Fees: Laboratory course fee will be assessed.

Required Course Materials:

- **Modern Physics**, **2nd Ed.**, by Randy Harris, Pearson Addison-Wesley, New York, c.2008. We will focus on topics from the first 8 chapters. **Homework assignments and due dates will be posted on UTC Learn.**
- Lab materials will be posted on UTC Learn, **along with the lab schedule and due dates**..

Supplemental/Optional Course Materials: Additional references will be provided if needed.

Technology Requirements for Course: An internet connected device for accessing the course materials, a spreadsheet/graphing program for data analysis. Scientific calculator. You will be shown how to use each laboratory experimental apparatus when we use them.

Technology/Digital Literacy Skills Required for Course: Be able to use the items mentioned above.

Course Assessments and Requirements: The tentative grading weights are as follows:

Lab Reports	=	65%
Final Exam	=	20
Homework	=	15
		100%

Course Grading

Course Grading Policy: A tentative guide for the overall course grade will be: $A \geq 90 > B \geq 80 > C \geq 70 > D \geq 60 > F$.

No extra credit work other than that provided on homework, labs, and exams may be done to substitute for low grades or missed homework, quizzes, or exams. No exceptions.

Homework Instructions: Homework will be assigned from selected chapters in our text. Assignments will be due on the dates given below.

Instructor Grading and Feedback Response Time: Assignments will typically be returned within 1 week of the due date.

Course Policies

Late/Missing Work Policy:

It is the responsibility of the student to make up any missed experimental work. Missed

laboratory exercises must be rescheduled at the convenience of the instructor and any lab partners who may be necessary.Lab reports and homework will be accepted without penalty for one week after the due date; after that, they will be subject to a 20% penalty. NO EXCEPTIONS!

Course Attendance Policy: Mandatory. Practically every experiment requires a team of students to set up apparatus, measure and record data, and analyze the results. Also, the first part of classes will consist of lecture and/or discussion in which students are expected to participate.

Course Participation/Contribution:

See attendance policy above. In addition, students are not allowed to submit a lab report for labs in which they did not participate.Please note the following: a) Each person is responsible for their own report. After completion of the data taking, you may wish to discuss your interpretation of the data with your partner, but you must write your own report independently. Word-processed reports are preferred; calculations may be done by hand. b) Data must not be shared by one group of lab partners with others, unless specifically directed to do so by the instructor. c) The emphasis in the reports is to be on the data and its interpretation, graphical analysis, and sources of error (which should be quantified if possible). If you feel that a problem was encountered in data taking which caused you to make a departure from the stated experimental method, then write out the steps which you took in detail. d) This course requires a high degree of responsibility and maturity on the part of the student: your attendance and participation is vital. Several of the experiments will require the use of outside material (which will be provided, or placed on reserve in the library) in order for you to understand the basic physics underlying the data. If you cannot make a class meeting, it is your responsibility to make up the session at the convenience of your partner (if required) and the instructor. Students should feel free to discuss course material/homework with me, during my office hours or by appointment, after first trying to work things out for themselves. Please remember that I am here to help you, but I am not here to do the work for you!

Course Calendar/Schedule: Each class meeting will consist of a lecture from the textbook followed by working on one of the following labs. **Students are expected to come to class with the assigned material read beforehand.**

Tentative Lab Schedule

We will split into smaller lab groups as much as possible, and each group will be performing a different experiment each day. **Again, in order to be prepared, it is imperative that you read the lab manual before class each day!**

8/25 Intro to Class; Discuss Ch. 1

First round of experiments start (3 groups of students; each experiment takes two weeks):
9/1 Muon Lifetime Measurement / Electron e/m Measurement / Single Photon Interference
9/8 Continue Muon Lifetime / Electron e/m / Single Photon Interference
9/15 Second experiment from above rotation
9/22 Continue second experiment
9/29 Third experiment from above rotation
10/6 Continue third experiment

Second round of experiments start (3 groups of students; each experiment takes one week):
10/13 Photoelectric Effect / Gamma Ray Spectroscopy / Frank-Hertz Experiment
10/20 Second experiment from above rotation
10/27 Third experiment from above rotation

11/3 Radioactive Decay and Half-life (Everyone does this one, but broken into groups)
11/10 Gone to conference (SESAPS)
11/17 Review and Catch-up Day (If Needed)
11/24 No Class (Thanksgiving Break)
12/1 Final Exam (Open Book and Notes)

Lab Report and Homework Assignment Due Dates:

9/15 First expt. from Muon Lifetime / Electron e/m / Single Photon Interference
9/22 ---
9/29 Ch. 2 Homework due (problems 18, 21, 23, 45, 62, 97)
10/6 Second expt. from Muon Lifetime / Electron e/m / Single Photon Interference
10/13 Third expt. from Muon Lifetime / Electron e/m / Single Photon Interference
10/20 First Expt. From Photoelectric Effect / Gamma Ray / Frank-Hertz
10/27 Ch. 3 Homework Due (problems 17, 23, 28, 36, 41, 46)
11/3 Second Expt. From Photoelectric Effect / Gamma Ray / Frank-Hertz
11/10 Third Expt. From Photoelectric Effect / Gamma Ray / Frank-Hertz
11/17 Radioactive Decay and Half-life due
12/1 Ch. 4 Homework due (problems 13, 31, 32, 33, 43, 48, 57)

Tuesday 12/5 1 PM All assignments must be turned in. Absolutely nothing accepted after this date!

The University of Tennessee at Chattanooga

Introduction to Quantum Mechanics

Spring 2023

PHYS 4110, Section 01, CRN 24912, Face-to-Face, 3 Credit Hours

Instructor: Dr. Tian Li

Email and Phone Number: tian-li@utc.edu, (423) 425-1766

Office Hours and Location: Tue. & Thu. 1:30-3:30 PM (or by appt.), Grote 203

Course Meeting Days, Times, and Location: Tue. & Thu. 9:25 - 10:40 AM, Grote 103

Course Catalog Description: Basic elements and principles of quantum physics: probability waves, the Schrodinger equation, expectation values and operator formalism, the hydrogen atom, radiation processes.

Course Pre/Co Requisites: Prerequisites: PHYS 2310 and 2310L and PHYS 2320 and 2320L, or PHYS 1040 and 1040L; and MATH 2450 or MATH 2550 or MATH 2560; or department head approval.

Course Student Learning Outcomes: Welcome to Introductory Quantum Mechanics! The objectives of this course are to present you with a basic vocabulary of quantum physics: its terms, concepts, and mathematical foundations. We shall emphasize those aspects which set the quantum world apart from that of classical physics, but we shall also -- whenever possible -- utilize Newtonian physics to make our crossing into the abstract microworld more comfortable. You are encouraged to read deeply (i.e., not just from the required text), to ask questions of yourself as well as of your instructor, and to allow yourself enough time to really ***think*** about the ideas that are discussed in class and in the text. You should expect to find this course to be challenging but also fascinating, and ultimately gain from it a heightened respect for both the curiosity and the ingenuity of humankind.

Required Course Materials: The required text is **Introduction to Quantum Mechanics**, third edition, by David J. Griffiths. We will focus on part 1, mainly chapters 1-4. We will cover additional topics from part 2 if time allows.

Technology Requirements for Course: access to a computer (such as those found in any UTC computer lab) and a scientific calculator.

Technology Skills Required for Course: be able to use your UTC email account, a scientific calculator, and access UTC Learn.

Technology Support: If you have problems with your UTC email account or with UTC Learn, contact IT Solutions Center at 423-425-4000 or email itsolutions@utc.edu.

Course Assessments and Requirements: the ***tentative*** grading plan will be as follows:

Exam 1	=	25%
Exam 2	=	25%
Homework and Quizzes	=	25%
Final Exam	=	25%
		100%

We will have two in-class exams over the course of the semester, a homework assignment for each chapter, and a final exam. Quizzes and other assignments may be given as needed. All due dates will be announced in class and on UTC Learn at least a week in advance.

Course Grading

Course Grading Policy: Your grade will be determined based on the graded materials outlined above. A guide for determining the overall course grade is: 90-100% = A; 80-89% = B; 70-79% = C, 60-69% = D; <60% = F. Final grades will be rounded precisely. *If you have an 89.4% final grade, this is a B. If you have a 69.5%, this is a C.*

Instructor Grading and Feedback Response Time: Assignments will typically be returned within 1 week of being submitted.

Course and Institutional Policies

Late/Missing Work Policy: Exams may only be retaken due to (a) illness (a doctor's excuse is required), or (b) a family emergency (verification obtained from UTC CARES will be requested). Make-up exams must be scheduled within 3 days of the student's return to classes. Please note that ***make-up exams will exceed the original exam in difficulty***. **Quizzes** which are missed ***cannot*** be made up. **Homework** assignments that are more than one week late ***will receive a 20% penalty***. **ANY ASSIGNMENT MORE THAN ONE WEEK LATE WILL BE GIVEN A ZERO. No exceptions!**

Student Conduct Policy: UTC's Academic Integrity Policy is stated in the Student Handbook.

Honor Code Pledge: I pledge that I will neither give nor receive unauthorized aid on any test or assignment. I understand that plagiarism constitutes a serious instance of unauthorized aid. I further pledge that I exert every effort to ensure that the Honor Code is upheld by others and that I will actively support the establishment and continuance of a campus-wide climate of honor and integrity.

Course Attendance Policy: Attendance in lecture is ***required***. Since the majority of material covered on exams and homework assignments will also be covered in class lectures, those students who attend regularly and take good notes tend to have a definite advantage on assignments. Those students having borderline grades at the end of the

course ***may*** be helped toward the higher grade if they have maintained a very strong record of attendance ***and*** participation in the class

Course Participation/Contribution: Students are expected to attend each class and participate in discussion. Asking questions to the instructor and answering those posed by him is strongly encouraged.

Course Learning Evaluation: Course evaluations are an important part of our efforts to continuously improve the learning experience at UTC. Toward the end of the semester, you will receive a link to evaluations and you are expected to complete them. We value your feedback and appreciate you taking time to complete the anonymous evaluations.

Course Calendar/Schedule: ***tentative*** dates are as follows:

Tue 1/10 – Tue 1/24 Chapter 1: The Wave Function
Thu 1/26 – Thu 2/16 Chapter 2: Time-Independent Schrodinger Equation
Tue 2/21: Exam 1
Thu 2/23 – Tue 3/21 Chapter 3: Formalism (and Appendix if necessary)
Tue 3/14 – Thu 3/16 Spring Break (No class)
Thu 3/23: Exam 2
Tue 3/28 – Thu 4/20 Chapter 4: Quantum Mechanics in Three Dimensions
Thu 4/27: Final Exam 8:00 – 10:00 AM

Finally... Students should feel free to discuss course material/homework with me, during my office hours or by appointment, after ***first*** trying to work things out for themselves. Please remember that I am here to help you, but I am ***not*** here to do the work for you!

The University of Tennessee at Chattanooga

Physics of living systems

Spring 2023

Physics, 4300, CRN 22646, face to face, credit hours 3

Instructor: Dr. Luis E. Sanchez Diaz

Email and Phone Number: luis-sanchezdiaz@utc.edu and (423) 425-4546

Office Hours and Location: : Monday 11:00 AM – 1:00 PM, Wednesday 12 PM-1 PM. Tuesday and Thursday 10:00 AM – 12:00 PM, and in Grote Hall room 201. If you cannot attend my office hours, please email me with your questions any time; I will respond within 24 hours. Phone and virtual appointments are available as needed.

Course Meeting Days, Times, and Location: TR (12:15PM – 1:30 PM) in GROTE 103. Please arrive on time so that you do not miss any announcements

Course Catalog Description: Introduction to basic biophysical processes occurring at the cellular level. Emphasis on energy transformations, and experimental techniques of biophysics

Course Pre/Co Requisites: Prerequisites: PHYS 2310 and PHYS 2310L and PHYS 2320 and PHYS 2320L, or PHYS 1040 and 1040L; and PHYS 3110 or CHEM 1120; and MATH 1960; or department head approval

Course Student Learning Outcomes: Upon successful completion of this course, learners will be able to

1. Explain intellectual foundations, conceptual approaches, and methodologies of biophysics.
2. Understand and explain scientific terminology.
3. Construct graphic and analytical models from a description of a specific natural phenomenon.
4. Formulate a hypothesis based on empirical data.
5. Apply the scientific method to solve problems.
6. Design experiments to test hypotheses.
7. Express conclusions and implications from scientific experiments using a variety of methods.
8. Experience the methods and technology of scientific inquiry.
9. Demonstrate significant concepts of the discipline
10. Use scientific technology to gather and interpret data.
11. Practice the development of independent thought.

Required Course Materials: *Biological Physics from Philip Nelson and Physical Biology of the Cell from Rob Phillips, Jane Kondev, and Julie Theriot.* We will make use of a variety of archival resources accessible from UTC Learn (Canvas), the Internet or the Library Reserves; (2) Microsoft Office: available to UTC students FREE OF CHARGE. To use this, students can click on "Microsoft Online Portal" to get Office 365 for free: https://www.utc.edu/information-technology/services/software-students.php

Technology Requirements for Course: You need access to a computer with a reliable internet connection to complete this course. Test your computer set up and browser for compatibility with UTC Learn at http://www.utc.edu/learn/getting-help/system-requirements.php. As there are videos with sound that you must watch, you will also need speakers or headphones. You should also have an updated version of Adobe Acrobat Reader, available free from https://get.adobe.com/reader/.

Technology Skills Required for Course: These include using Microsoft Word and Excel, using the learning management system (UTC Learn), using MOCSNet email, creating and submitting files to UTC Learn, copying and pasting, and downloading and installing software. As there are videos with sound that you must watch, you will also need speakers or headphones

Technology Support: If you have problems with your UTC email account or with UTC Learn, contact IT Solutions Center at 423-425-4000 or email itsolutions@utc.edu.

Course Assessments and Requirements: the tentative grading weights will be as follows:

Homework	20%
3 Tests	65%
Best 2 of 3 Quizzes	15%
Total	100%

As evaluative measures, there will be three scheduled 1-hour tests, 4 brief (20-25 min.) quizzes, and a final exam. **Students are expected to come to class with the assigned material read beforehand.**

Homework Instructions: Homework is a vital part of the learning process at most levels of Physics. Homework will be handled in class.

Course Grading

Course Grading Policy: A *tentative guide* for the overall course grade will be: A ≥ 90 > B ≥ 80 > C ≥ 70 > D ≥ 60 > F.

Instructor Grading and Feedback Response Time: I will try my best to grade all assignments within one week of the due date and provide written feedback when necessary.

Course and Institutional Policies

Late/Missing Work Policy: : Homework may be submitted up to two (2) days late with a 5% deduction for each late day. Test may not be taken late. However, if you will miss an exam due to a planned event, you may take the exam early by contacting the professor at least three (3) days in advance. No exams will be given after the scheduled date/time.

Student Conduct Policy UTC's Academic Integrity Policy is stated in the Student Handbook (https://www.utc.edu/dean-students/student-handbook.php).

Honor Code Pledge: I pledge that I will neither give nor receive unauthorized aid on any test or assignment. I understand that plagiarism constitutes a serious instance of unauthorized aid. I further pledge that I exert every effort to ensure that the Honor Code is upheld by others and that I will actively support the establishment and continuance of a campus-wide climate of honor and integrity.

Course Attendance Policy: Each student is expected to attend every class and maintain an environment conducive to learning. This means being respectful to fellow classmates, the instructor, and any visitors who may be present. Students are required to attend class. Students who miss more than three lectures will have 1 point deducted from their final grade for each additional absence. For example, a student with a final grade of 90 who missed four classes would have their final grade reduced from a 90 (A) to an 89 (B). Do not miss class and use up your three absences unnecessarily. That way, if you do get sick or have some other problem, you will not be penalized for it.

Course Participation/Contribution: : The course contains several learning objectives that are critical to building a foundation in science. For this reason, several methods will be employed, including (but not limited to): lecture, group work, pre-class videos, and post-class work. To be successful in this course, I recommend that you engage in all methods.

Course Learning Evaluation: Course evaluations are an important part of our efforts to continuously improve the learning experience at UTC. Toward the end of the semester, you will receive a link to evaluations and are expected to complete them. We value your feedback and appreciate you taking time to complete the anonymous evaluations.

UTC Bookstore: The UTC Bookstore will price match Amazon and BN.com prices of the exact textbook - same edition, ISBN, new to new format, used to used format, and used rental to used rental format, with the same rental term. For more information, go to the Bookstore Price Match Program webpage, visit the bookstore, email sm430@bncollege.com or call 423-425-2184.

Course Calendar/Schedule: Click here to enter text.

Click here to enter text.

	Chapters	**Assessments**
Tue. 1/10	Introduction; Discussion of Syllabus and Outcomes.	
Thu. 1/12-Tue. 1/17	Unit 1: Cells the basics units of life and unit 2: Model systems	1/12 Homework 1 assigned
Thu. 1/19-Tue. 1/24	Unit 3: Biology of numbers	1/19 Homework 1 due 1/19 Homework 2 assigned
Thu. 1/26-Tue. 1/31	Unit 4: Physics of life	1/26 Homework 2 due **1/26 Quiz 1** 1/26 Homework 3 assigned
Thu.02/02-Tue. 2/07	Unit 5: Mechanical and Chemical equilibrium in cells	2/02 Homework 3 due 2/02 Homework 4 assigned
Thu 2/09	**Exam 1(1-4)**	**Exam 1(1-4)** 2/09 Homework 4 due
Tue. 2/14-Thu 2/16	Unit 6: Simple application of statistical mechanics	2/14 Homework 5 assigned
Tue. 2/21-Thu 2/23	Unit 7: Two states systems	**2/23 Quiz 2** 2/21 Homework 5 due 2/21 Homework 6 assigned
Tue. 2/28-Thu 3/02	Unit 8: Random walks and macromolecules	2/28 Homework 6 due
Tue. 3/07-Thu 3/09	Unit 9 Life in the low Reynolds number world	3/07 Homework 7 assigned
Tue. 3/14-Thu 3/17	**Spring break**	**Spring break**
Tue. 3/21	**Exam 2 (5-9)**	3/17 Homework 7 due
Thu 3/23-Tue. 3/28	Unit 10: Membranes	3/23 Homework 8 assigned
Thu. 3/30-Tue 4/04	Unit 12: Electrostatic of salty solutions	**4/04 Quiz 3** 4/04 Homework 8 due 4/04 Homework 9 assigned
Thu. 4/6-Tue 4/11	Unit 12: Beam theory	4/11 Homework 9 due 4/11 Homework 10 assigned

Thu. 4/13-Tue. 4/18	Unit 13: Biological electricity	
Thu 4/20	**Exam 3 (10-13)**	**Exam 3 (12-13)** 4/20 Homework 10 due
No Final exam		

The University of Tennessee at Chattanooga

Physics of living systems

Spring 2023

Physics, 4300L, CRN 22647, face-to-face, credit hours 1

Instructor: Dr. Luis E. Sanchez Diaz

Email and Phone Number: luis-sanchezdiaz@utc.edu and (423) 425-4513

Office Hours and Location:: Monday 11:00 AM – 1:00 PM, Wednesday 12 PM-1 PM. Tuesday and Thursday 10:00 AM – 12:00 PM, and in Grote Hall room 201. If you cannot attend my office hours, please email me with your questions any time; I will respond within 24 hours. Phone and virtual appointments are available as needed.

Click here to enter text.

Course Meeting Days, Times, and Location: Thursday (1:40 PM – 3:30 PM) in GROTE 104. Please arrive on time so that you do not miss any announcements

Course Catalog Description: Laboratory to accompany PHYS 4300. Laboratory exercises will center on computational and experimental methods biophysicists routinely use to qualitatively and quantitatively investigate the properties of biological macromolecules.

Course Pre/Co Requisites: Corequisite: PHYS 4300 or department head approval.

Course Student Learning Outcomes: Upon successful completion of this course, learners will be able to:

1. Explain intellectual foundations, conceptual approaches, and methodologies of biophysics.
2. Understand and explain scientific terminology.
3. Construct graphic and analytical models from a description of a specific natural phenomenon.
4. Formulate a hypothesis based on empirical data.
5. Apply the scientific method to solve problems.
6. Design experiments to test hypotheses.
7. Express conclusions and implications from scientific experiments using a variety of methods.
8. Experience the methods and technology of scientific inquiry.
9. Demonstrate significant concepts of the discipline.
10. Use scientific technology to gather and interpret data.
11. Practice the development of independent thought.

Required Course Materials: We will make use of a variety of archival resources accessible from UTC Learn (Canvas), the Internet or the Library Reserves; (2) Microsoft Office: available to UTC students FREE OF CHARGE. To use this, students can click on "Microsoft Online Portal" to get Office 365 for free: https://www.utc.edu/information-technology/services/software-students.php

Technology Requirements for Course: You need access to a computer with a reliable internet connection to complete this course. Test your computer set up and browser for compatibility with UTC Learn at http://www.utc.edu/learn/getting-help/system-requirements.php. As there are videos with sound that you must watch, you will also need speakers or headphones. You should also have an updated version of Adobe Acrobat Reader, available free from https://get.adobe.com/reader/.

Technology Skills Required for Course: These include using Microsoft Word and Excel, using the learning management system (UTC Learn), using MOCSNet email, creating and submitting files to UTC Learn, copying and pasting, and downloading and installing software. Students should also be prepared to learn how to use additional scientific analysis software as part of the laboratory exercises, but prior experience or knowledge of these is not necessary.

Technology Support: If you have problems with your UTC email account or with UTC Learn, contact IT Solutions Center at 423-425-4000 or email itsolutions@utc.edu.

Course Assessments and Requirements: the tentative grading weights will be as follows:

Lab reports	80%
Participation	20%
Total	100%

Students will learn different experimental and computational techniques used to study the physics properties of biological systems. Students need to submit a full report after completing the experiment. The report should include an introduction, theoretical framework, methodology, results, and conclusions.

Course Grading

Course Grading Policy: A *tentative guide* for the overall course grade will be: A ≥ 90 > B ≥ 80 > C ≥ 70 > D ≥ 60 > F.

Instructor Grading and Feedback Response Time: I will try my best to grade all assignments within one week of the due date and provide written feedback when necessary.

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Course Calendar/Schedule: Click here to enter text.

Click here to enter text.

Dates	Sections	
Jan 12		**No lab**
Jan 19		**Syllabus and Introduction and Computational requirements and lab safety**
Jan 26 **Feb 2** **Feb 9**	**1**	**Tracking colloidal particles using optical microscope**
Feb 16 to March 2	**2**	**Introduction to GROMACS, NAMD AND LAMMPS**
March 9 to March 23	**3**	**Rheology of colloidal particles and Bacteria** **SPRING BREAK MARCH 13-19**
March 30 to April 13	**4**	**Fluorescence of E. Coli and proteins**
April 13-20	**5**	**Atomic force microscope of colloidal particles**