

## ***Course Syllabus***

---

### **Course Information:**

<i>Course Number/Section</i>	Physics 4352.001
<i>Course Title</i>	Concepts of Modern Physics
<i>Term</i>	Fall 2024
<i>Days &amp; Times</i>	MW 10:00 AM – 11:15 AM
<i>Classroom</i>	SLC 2.302

### **Professor Contact Information:**

<i>Professor</i>	Prof. Ivan Vasko
<i>Office Phone</i>	(510) 495-4902
<i>Email Address</i>	Ivan.Vasko@UTDallas.edu
<i>Office Location</i>	WTC 2.708
<i>Office Hours</i>	Thursdays 1:00 - 3:00 PM

### **Teaching Assistant Contact Information**

<i>Name</i>	David Tonoian
<i>Email Address</i>	David.Tonoian@UTDallas.edu
<i>Office Location</i>	WTC 2.714
<i>Online Office Hours</i>	Fridays 1-3 pm, and by appointment via email / MS Teams

### **Course Pre-requisites and Co-requisites:**

Pre-requisite: PHYS 4302 (Quantum Mechanics II). If a course equivalent to PHYS 4302 has not yet been taken or is being taken concurrently, you must ask Prof. Vasko for permission to take PHYS 4352.

### **Course Description:**

A 3 credit hour course applying basic principles of quantum mechanics, statistical physics, and special relativity to modern topics in physics, such as atomic & molecular physics, solid-state physics, quantum optics, nuclear physics, and elementary particle physics. Topics may vary according to student interest.

### **Student Learning Objectives:**

Upon completing this course, students will develop an understanding of:

1. Quantum statistical mechanics and applications to photons, lasers, and properties of crystals
2. Fundamental theory of electrical conduction in semiconductors and metals
3. Quantum phases and particles
4. Special relativity and principle of invariance
5. General principles of symmetry in physics
6. Basic principles of quantum field theoretical methods

**Textbook and Materials:**

1. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles (2<sup>nd</sup> edition) by Eisberg and Resnick (John Wiley & Sons, ISBN 978-0-471-87373-0)
2. Optional / Suggested Text: The Feynman Lectures on Physics (on reserve at McDermott Library)

Other Materials: calculator with trigonometry functions, but without web access capability

**Course Assignments and Requirements:**

There will usually be one homework assignment each week, handed out and due on Wednesdays, except for the week preceding an exam. Homework assignments and solutions will be posted on the e-Learning website for this course. Students may work together on homework assignments, but what you turn in should be an honest reflection of your own understanding.

There will be one in-class hour exams, tentatively scheduled for 10/14.

Instead of a final exam, there will be a required term paper, due on 12/05, and an accompanying in-class presentation, to be given during the last few classes. Each student must do his/her own term paper and presentation. The topic of the term paper and presentation will be on the physics of any Nobel Prize in Physics awarded between 1960 and 2014. No two students may choose the same Nobel Prize; choice will be first-come, first-served. Details of the term paper and presentation requirements can be found on the eLearning site for this class.

**Grading Policy:**

30% Homework; 15% Hour Exam; 15% Class Participation & Attendance; 40% Term Paper and Presentation.

Grades: A (90 and above), B (80-89.9), C (70-79.9), D (60-69.9), F (below 60). Each grade (except F), for example grade A, has three finer grades: A- (90-93.2), A (93.3-96.5), A+ (96.6 and above).

**General Course Mechanics:**

*Late Homeworks:* Not accepted for any reason after solutions are posted on eLearning, usually by close-of-business on the day homework is due.

*Make-up Exam:* Only in emergency cases beyond the student's control. Proof must be supplied to document the emergency.

*Term Paper:* Due by email on 12/05/2024. Late term papers will not be accepted.

*Presentation:* Required in-class on the date scheduled. No make-ups.

*Class Participation:* Attendance and interactions (questions, discussions) are strongly encouraged during lectures, and especially at the student presentations.

*Class Attendance:* Very Strongly recommended. Attendance is REQUIRED during the student presentations.

**Assignments & Academic Calendar** (This is Only a Rough Guide. Topics and time spent on topics can and will be changed as we go along to match student interests)

Date	Lecture	Reading Guide
08/19	Course description, Historic Review of Quantum Mechanics	3-1, 3-2, 3-4
08/21	Uncertainty Principle, Two Identical Particles	3-3, 3-5, 9-1, 9-2, 11-1, 11-2
08/26	Many Identical Particles: Planck Distribution	11-7 to 11-9
08/28	Bosons	11-3 to 11-6, 11-8 to 11-10
09/02	Labor Day Holiday	
09/04	Lasers: General Theory	11-7
09/09	Lasers: Practical	
09/11	Fermions and the Exclusion Principle	9-3, 9-4
09/16	Ground State of Many Identical Fermions	11-11
09/18	Electrons in Crystals: Bloch Waves	13-1, 13-2, 13-6
09/23	Electrical Conduction in Metals	13-4, 13-5
09/25	Electron Energy Bands in Crystals	13-3, 13-7
09/30	Electrons and Holes in Semiconductors	13-9
10/02	Semiconductors	13-10
10/07	Superconductivity (phenomena)	14-1
10/09	Superconductivity (theory)	
10/14	Hour Exam	
10/16	Transformations and Symmetry	
10/21	Special Theory of Relativity	A-1 to A-9
10/23	Space-Time and Relativistic 4-vectors	A-9 to A-17
10/28	Relativistic Momentum and Energy	
10/30	Fancy Notation: Covariance and Contravariance	
11/04	Gauge Transformations and U(1) Symmetry	18-3, 18-4, 18-6
11/06	Simple Relativistic Quantum Mechanics	17-4
11/11	Quantum Fields and Particles: 2 <sup>nd</sup> Quantization	
11/13	Plasma: The fourth state of matter	
11/18	Student presentations	
11/20	Student presentations	
11/25	Fall Break	
11/27	Fall Break	
12/02	Student presentations	
12/04	Student presentations	

## Course Policies

### *Exams*

1. **Calculators are necessary** for the hour exam. **Any calculators that have internet access will not be allowed in the exam.** A scientific calculator that has trig functions should be all that is used on the exams.
2. **You must show all work for hour exam problems (excluding multiple choice questions) to receive partial credits.**
3. **Hour exam will cover both in-class examples and homework.**
4. **You will be allowed to bring one 8.5" x 11" piece of paper with whatever you wish written on both sides to the hour exam.** These papers are the only information you may bring to the exam.
5. **No phones of any kind or any devices with internet access are allowed to be used during exam.**
6. You may not leave the exam room with the exam or your answers.
7. You are responsible for all the reading assignments even if we do not discuss them in class.
8. A missed hour exam may be made up only in emergency cases beyond the student's control. Proof must be supplied to document the emergency.

### *Homework*

1. There will usually be one homework assignment each week, except in the week preceding the hour exam, assigned each Wednesday and due the following Wednesday.
2. Homeworks are due in class on the date specified.
3. Late homework may be accepted with reasonable explanation before solutions are posted on eLearning. Late homework will NOT be accepted for any reason after solutions are posted on eLearning..
4. You are welcome to work together on homework but everyone must do his or her own problems.

### *Class Notes / Attendance*

1. You can go to the course under eLearning and download lecture notes that form part (but NOT ALL) of the lectures. Lecture notes are generally available by the end of the day of each lecture. Be careful these lectures are not complete and will not be enough to pass the class.
2. The reading assignment includes the relevant sections from the chapters given above and the lecture notes available on eLearning. Therefore it is best if you do the **reading before the lecture.**
3. Attendance at lectures and participation in class is a component of your grade. Please be aware that it is highly unlikely that you do well in the class without regular attendance at lectures.
4. **Attendance at the student presentation classes is required**, whether or not you are scheduled to present in that class. These will be the only classes where the instructor will take formal attendance. Participation in questions and discussions during student presentations will count towards grade.

### *Classroom Citizenship*

1. Cell phones must be turned off during all class time.
2. Do not disrupt the class by getting up and leaving in the middle of class.

## **Student Conduct & Discipline**

The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UTD publication, *A to Z Guide*, which is provided to all registered students each academic year.

The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the *Rules and Regulations, Board of Regents, The University of Texas System, Part 1, Chapter VI, Section 3*, and in Title V, Rules on Student Services and Activities of the university's *Handbook of Operating Procedures*. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/883-6391).

A student at the university neither loses the rights nor escapes the responsibilities of citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.

## **Academic Integrity**

The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work.

Scholastic dishonesty includes, but is not limited to, statements, acts or omissions related to applications for enrollment or the award of a degree, and/or the submission as one's own work or material that is not one's own. As a general rule, scholastic dishonesty involves one of the following acts: cheating, plagiarism, collusion and/or falsifying academic records. Students suspected of academic dishonesty are subject to disciplinary proceedings.

Plagiarism, especially from the web, from portions of papers for other classes, and from any other source is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details). This course will use the resources of turnitin.com, which searches the web for possible plagiarism and is over 90% effective.

## **Email Use**

The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. The university encourages all official student email correspondence be sent only to a student's U.T. Dallas email address and that faculty and staff consider email from students official only if it originates from a UTD student account. This allows the university to maintain a high degree of confidence in the identity of all individual corresponding and the security of the transmitted information. UTD furnishes each student with a free email account that is to be used in all communication with university personnel. The Department of Information Resources at U.T. Dallas provides a method for students to have their U.T. Dallas mail forwarded to other accounts.

## **Withdrawal from Class**

The administration of this institution has set deadlines for withdrawal of any college-level courses. These dates and times are published in that semester's course catalog. Administration procedures must be followed. It is the student's responsibility to handle withdrawal requirements from any class. In other words, I cannot drop or withdraw any student. You must do the proper paperwork to ensure that you will not receive a final grade of "F" in a course if you choose not to attend the class once you are enrolled.

## **Student Grievance Procedures**

Procedures for student grievances are found in Title V, Rules on Student Services and Activities, of the university's *Handbook of Operating Procedures*.

In attempting to resolve any student grievance regarding grades, evaluations, or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originates (hereafter called "the respondent"). Individual faculty members retain primary responsibility for assigning grades and evaluations. If the matter cannot be resolved at that level, the grievance must be submitted in writing to the respondent with a copy of the respondent's School Dean. If the matter is not resolved by the written response provided by the respondent, the student may submit a written appeal to the School Dean. If the grievance is not resolved by the School Dean's decision, the student may make a written appeal to the Dean of Graduate or Undergraduate Education, and the dean will appoint and convene an Academic Appeals Panel. The

decision of the Academic Appeals Panel is final. The results of the academic appeals process will be distributed to all involved parties.

Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations.

### **Incomplete Grade Policy**

As per university policy, incomplete grades will be granted only for work unavoidably missed at the semester's end and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight (8) weeks from the first day of the subsequent long semester. If the required work to complete the course and to remove the incomplete grade is not submitted by the specified deadline, the incomplete grade is changed automatically to a grade of **F**.

### **Disability Services**

The goal of Disability Services is to provide students with disabilities educational opportunities equal to those of their non-disabled peers. Disability Services is located in room 1.610 in the Student Union. Office hours are Monday and Thursday, 8:30 a.m. to 6:30 p.m.; Tuesday and Wednesday, 8:30 a.m. to 7:30 p.m.; and Friday, 8:30 a.m. to 5:30 p.m.

The contact information for the Office of Disability Services is:

The University of Texas at Dallas, SU 22

PO Box 830688

Richardson, Texas 75083-0688

(972) 883-2098 (voice or TTY)

Essentially, the law requires that colleges and universities make those reasonable adjustments necessary to eliminate discrimination on the basis of disability. For example, it may be necessary to remove classroom prohibitions against tape recorders or animals (in the case of dog guides) for students who are blind. Occasionally an assignment requirement may be substituted (for example, a research paper versus an oral presentation for a student who is hearing impaired). Classes enrolled students with mobility impairments may have to be rescheduled in accessible facilities. The college or university may need to provide special services such as registration, note-taking, or mobility assistance.

It is the student's responsibility to notify his or her professors of the need for such an accommodation. Disability Services provides students with letters to present to faculty members to verify that the student has a disability and needs accommodations. Individuals requiring special accommodation should contact the professor after class or during office hours.

### **Religious Holy Days**

The University of Texas at Dallas will excuse a student from class or other required activities for the travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, Tax Code, Texas Code Annotated.

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

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

### **Off-Campus Instruction and Course Activities**

Off-campus, out-of-state, and foreign instruction and activities are subject to state law and University policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at the website address given below. Additional information is available from the office of the school dean. ([http://www.utdallas.edu/Business Affairs/Travel\\_Risk\\_Activities.htm](http://www.utdallas.edu/Business Affairs/Travel_Risk_Activities.htm))

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