PHY 5520 – THEORETICAL PHYSICS

OAKLAND UNIVERSITY, CAS, PHYSICS

COURSE INFORMATION

PHY 5520, CRN 45640

FALL 2019, MSC 384, 4.0 CREDIT HOURS

TUESDAY AND THURSDAY, 5:30-7:17 PM / SEPTEMBER 5 – DECEMBER 5

FINAL EXAM: DECEMBER 10, 7:00-10:00 PM

Course (catalog) description: Topics and techniques common to graduate physics courses: partial differential equations, eigenvalue problems, special functions, spherical harmonics, Green’s functions, variational methods, linear vector spaces, tensors.

Recommended prerequisites: PHY 3610, PHY 3710, and PHY 3810

Course format: On-campus meetings

PROFESSOR INFORMATION

Name: Dr. Vasyl Tyberkevych

Office Location: 274 HHS (Hannah Hall of Science)

My student hours (office hours) are on Thursdays 3:00-4:00 PM or by appointment.

You can reach me at 248-370-3421 or at tyberkev@oakland.edu.

Email Policy: Email is the best way to contact me. I will make every effort to return your email within 24 hours.

LEARNING OUTCOMES

As a result of this course, students will:

● Be familiar with main mathematical concepts and methods used in theoretical physics
● Be able to solve problems using various theoretical physical methods
TEXTBOOKS AND MATERIALS


Previous editions may be acceptable. Contact me if you have an older edition of the textbook.

ASSIGNMENTS

**Exams** (65 %)
- Midterm Exam 1 – 20 %
- Midterm Exam 2 – 20 %
- Final Exam – 25 %

**Homework** (27 %)
- 9 homework assignments × 3 % each

**Participation** (8 %)
- Based on attendance and in-class activity

**Extra Credit** (up to 5 %)
- To be discussed at the first lecture

GRADING

- **A**: Comprehensive, thorough coverage of all objectives, required content, critical and higher-level thinking, original and creative, sound use of English skills, both written and oral
- **B**: Competent, mastery of basic content and concept, adequate use of English
- **C**: Slightly below average work, has met minimum requirements but with difficulty
- **D**: Has not met requirements of assignment/course, has significant difficulties in many areas
- **F**: Has not completed requirements; has not officially withdrawn from course before drop date


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<th>Scale as of Fall 2018</th>
<th>Minimum %</th>
<th>Old Scale</th>
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**Using Moodle and Other Technologies**

**Using Moodle**
- Some of the materials associated with class will be disseminated through Moodle (e.g., exam problem solutions). Students should ensure they have access to Moodle (moodle.oakland.edu).

**In-Class Technology Policy**
- You are welcome to bring laptops, tablets, and cell phones to class. Please make sure to turn phones on silent or vibrate. Please use these devices only for note taking or for activities I ask you to engage in during class. See the Professionalism/Civility Policy regarding misuse of these technologies.

**Technology Back-up Plan**
- In the event that your computer crashes or internet goes down, it is essential to have a “backup plan” in place where you are able to log in using a different computer or travel another location that has working internet.
- Any files you intend to use for your course should be saved to a cloud solution (Google Drive, Dropbox, etc.) and not to a local hard drive, USB stick or external disk. Saving files this way guarantees your files are not dependent on computer hardware that could fail.

**Technology Help**
- For help using Moodle, use the Get Help link at the top of the Moodle page (moodle.oakland.edu).
For access to technology and in-person assistance, call or visit the Student Technology Center (Link to Student Technology Center: https://www.oakland.edu/stc/).

For general technology assistance, consult the OU Help Desk (Link to Help Desk: https://www.oakland.edu/helpdesk/).

**RESPECT RULES OF NETIQUETTE**
- Respect your peers and their privacy.
- Use constructive criticism.
- Refrain from engaging in inflammatory comments.

**CLASSROOM AND UNIVERSITY POLICIES**

**CLASSROOM BEHAVIOR**

1. **ACADEMIC CONDUCT POLICY.** All members of the academic community at Oakland University are expected to practice and uphold standards of academic integrity and honesty. Academic integrity means representing oneself and one’s work honestly. Misrepresentation is cheating since it means students are claiming credit for ideas or work not actually theirs and are thereby seeking a grade that is not actually earned. Following are some examples of academic dishonesty:
   a. **Cheating.** This includes using materials such as books and/or notes when not authorized by the instructor, copying from someone else’s paper, helping someone else copy work, substituting another’s work as one’s own, theft of exam copies, falsifying data or submitting data not based on the student’s own work on assignments or lab reports, or other forms of misconduct on exams.
   b. **Plagiarizing the work of others.** Plagiarism is using someone else’s work or ideas without giving that person credit; by doing this, students are, in effect, claiming credit for someone else’s thinking. Both direct quotations and paraphrases must be documented. Even if students rephrase, condense or select from another person’s work, the ideas are still the other person’s, and failure to give credit constitutes misrepresentation of the student’s actual work and plagiarism of another’s ideas. Buying a paper or using information from the World Wide Web or Internet without attribution and handing it in as one’s own work is plagiarism.
   c. **Falsifying records** or providing misinformation regarding one’s credentials.
   d. **Unauthorized collaboration** on computer assignments and unauthorized access to and use of computer programs, including modifying computer files created by others and representing that work as one’s own.

For more information, review OU’s Academic Conduct Regulations. (Link to Academic Conduct Regulations: https://www.oakland.edu/deanofstudents/policies/)

2. **BEHAVIORAL CODE OF CONDUCT.** Appropriate behavior is required in class and on campus. Disrespectful, disruptive and dangerous behavior are not conducive to a positive learning environment.
environment and may result in consequences. Core Standards for Student Conduct at OU includes

a. **Integrity.** See academic conduct policy points above.

b. **Community.** Policies regarding disruptive behavior, damage and destruction, weapons, and animals.

c. **Respect.** Policies regarding harassment, hazing, and sexual misconduct (Link to Sexual Misconduct policy: https://www.oakland.edu/policies/health-and-safety/625/)

d. **Responsibility.** Policies regarding alcohol, drugs, and other substances

See the [Student Code of Conduct](https://www.oakland.edu/deanofstudents/student-code-of-conduct/) for details.

**ACCOMMODATION AND SPECIAL CONSIDERATIONS**

Oakland University is committed to providing everyone the support and services needed to participate in their courses. Students with disabilities who may require special accommodations should make an appointment with campus [Disability Support Services (DSS)](https://www.oakland.edu/dss/). If you qualify for accommodations because of a disability, please submit to your professor a letter from Disability Support Services in a timely manner (for exam accommodations provide your letter at least one week prior to the exam) so that your needs can be addressed. DSS determines accommodations based on documented disabilities. Contact DSS at 248-370-3266 or by e-mail at dss@oakland.edu.

For information on additional academic support services and equipment, visit the [Study Aids webpage](https://www.oakland.edu/dss/) of Disability Support Services website.

**MENTAL HEALTH AND WELL-BEING**

Oakland University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, contact The OU Counseling Center at Graham Health at (248) 370-3465. Student resources can also be found at the [Dean of Students website](http://www.oakland.edu/deanofstudents) by clicking on Student Health & Safety Resources.

**ATTENDANCE POLICY**

Attendance is expected but not required. There are no scheduled makeup exams and no makeup assignments will be given. If you must miss a class due to an emergency, notify me as soon as possible, but not later than 24 hours after the missed class.

**EXCUSED ABSENCE POLICY**

This policy for university excused absences applies to participation as an athlete, manager or student trainer in NCAA intercollegiate competitions, or participation as a representative of Oakland University at academic events and artistic performances approved by the Provost or
designee. A student must notify and make arrangements with the professor in advance. For responsibilities and procedures see Academic Policies and Procedures. (Link to Academic Policies and Procedures: https://www.oakland.edu/provost/policies-and-procedures/)

**RELIGIOUS OBSERVANCES**
Student should discuss with professor at the beginning of the semester to make appropriate arrangements. Although Oakland University, as a public institution, does not observe religious holidays, it will continue to make every reasonable effort to help students avoid negative academic consequences when their religious obligations conflict with academic requirements. See The OU Diversity Calendar for more information. (Link to calendar: https://www.oakland.edu/diversity/calendar/)

**PREFERRED NAME AND PRONOUN**
If you do not identify with the name that is listed with the registrar's office, please notify me so that I may appropriately amend my records. In addition, if you prefer to go by a different pronoun, please inform me. For more information including a preferred first name on university records please review OU’s Preferred Name Policy (URL: oakland.edu/uts/common-good-core-resources/name-services/)

**SEXUAL MISCONDUCT**
Faculty and staff are responsible for creating a safe learning environment for our students, and that includes a mandatory reporting responsibility if students share information regarding sexual misconduct/harassment, relationship violence, or information about a crime that may have occurred on campus with the University. In such cases, the professor will report information to the campus’ Title IX Coordinator (Chad Martinez, chadmartinez@oakland.edu or 248-370-3496). You can report such incidents to the Dean of Students Office directly. Students who wish to speak to someone confidentially can contact the OU Counseling Center at 248-370-3465. Additionally, students can speak to a confidential source off-campus 24 hours a day by contacting Haven at 248-334-1274. The Dean of Students website provides more information on your options and support services. (oakland.edu/deanofstudents/sexual-assault-and-violence-initiative/students/)

**ADD/DROPS**
As a student, university policy officially gives you the responsibility to add and drop courses. Put in your calendar [deadline dates for dropping courses](https://www.oakland.edu/registrar/registration/dropornot/) (even if you think it won’t be necessary), and consult the [Drop or Not Guide](https://www.oakland.edu/registrar/registration/dropornot/) to make a well-informed decision before dropping a course.
FACULTY FEEDBACK: OU EARLY ALERT SYSTEM
As a student in this class, you may receive “Faculty Feedback” in your OU e-mail if your professor identifies areas of concern that may impede your success in the class. Faculty Feedback typically occurs during weeks 2-5 of the Fall and Winter terms, but may also be given later in the semester and more than once a semester. A “Faculty Feedback” e-mail will specify the area(s) of concern and recommend action(s) you should take. Please remember to check your OU email account regularly as that is where it will appear. This system is to provide early feedback and intervention to support your success. (Link to Faculty Feedback for students: https://www.oakland.edu/advising/faculty-feedback/)

EMERGENCY PREPAREDNESS
In the event of an emergency arising on campus, the Oakland University Police Department (OUPD) will notify the campus community via the emergency notification system. The professor of your class is not responsible for your personal safety, so therefore it is the responsibility of each student to understand the evacuation and “lockdown” guidelines to follow when an emergency is declared. These simple steps are a good place to start:

- OU uses an emergency notification system through text, email, and landline. These notifications include campus closures, evacuations, lockdowns and other emergencies. Register for these notifications at oupolice.com.
- Based on the class cellphone policy, ensure that one cellphone is on in order to receive and share emergency notifications with the professor in class.
- If an emergency arises on campus, call the OUPD at (248) 370-3331. Save this number in your phone, and put it in an easy-to-find spot in your contacts.
- Review protocol for evacuation, lockdown, and other emergencies via the classroom’s red books (hanging on the wall) and oupolice.com/emergencies.
- Review with the professor and class what to do in an emergency (evacuation, lockdown, snow emergency).

Violence/Active Shooter: If an active shooter is in the vicinity, call the OUPD at (248) 370-3331 or 911 when it is safe to do so and provide information, including the location and number of shooter(s), description of shooter(s), weapons used and number of potential victims. Consider your options: Run, Hide, or Fight.
Tentative Course Schedule

Week 1
- Thursday, September 5:
  Introduction of the course. Linear algebraic equations and determinants (Chapter 2.1)

Week 2
- Tuesday, September 10:
  Determinants, vectors, and matrices (Chapters 2.1, 2.2)
- Thursday, September 12:
  Vectors and matrices (Chapter 2.2, 3.1)

Week 3
- Tuesday, September 17:
  Vectors in 3D space, coordinate transformations (Chapters 3.1, 3.2, 3.3)
- Thursday, September 19:
  Vector fields, differential vector operators (Chapters 3.5, 3.6)
  Homework 1 (due date)

Week 4
- Tuesday, September 24:
  Vector integration (Chapter 3.7)
- Thursday, September 26:
  Integral theorems, Gauss law, Poisson equation (Chapters 3.8, 3.9)
  Homework 2

Week 5
- Tuesday, October 1:
  Curvilinear coordinates (Chapter 3.10)
- Thursday, October 3:
  Curvilinear coordinates (Chapter 3.10). Introduction to tensors (elements of Chapter 4)
  Homework 3

Week 6
- Tuesday, October 8:
  Midterm Exam 1: Determinants and matrices, vectors in 3D, differential operators,
  curvilinear coordinates (Chapters 2 and 3)
• Thursday, October 10:
  Functions and vectors in a Hilbert space, operators on functions (Chapter 5)

**WEEK 7**

• Tuesday, October 15:
  Matrix eigenvalue problem (Chapter 6)
• Thursday, October 17:
  Matrix eigenvalue problem (Chapter 6)

**Homework 4**

**WEEK 8**

• Tuesday, October 22:
  First-order ordinary differential equations (Chapter 7.1, 7.2)
• Thursday, October 24:
  Second-order differential equations (Chapter 7.3, 7.4, 7.7, 7.8)

**Homework 5**

**WEEK 9**

• Tuesday, October 29:
  Sturm-Liouville theory (Chapter 8)
• Thursday, October 31:
  Sturm-Liouville theory (Chapter 8)

**Homework 6**

**WEEK 10**

• Tuesday, November 5:
  **Midterm Exam 2: Vector spaces, eigenvalue problems, ordinary differential equations, Sturm-Liouville theory (Chapters 5-8)**
• Thursday, November 7:
  Partial differential equations (Chapter 9.1-9.3). Main equations of mathematical physics (elements of Chapter 9.5-9.7)

**WEEK 11**

• Tuesday, November 12:
  Separation of variables (Chapter 9.4-9.7)
• Thursday, November 14:
  Separation of variables (Chapter 9.5-9.7). Introduction to special functions (elements of Chapters 14-18)

**Homework 7**

Syllabus, PHY 5520, Dr. Vasyl Tyberkevych, Fall 2019
WEEK 12
- Tuesday, November 19:
  Green’s functions (Chapter 10)
- Thursday, November 21:
  Fourier series (Chapter 19)
  Homework 8

WEEK 13
- Tuesday, November 26:
  Fourier series and integral transforms (Chapters 19-20)
- Thursday, November 28: No classes, thanksgiving recess

WEEK 14
- Tuesday, December 3:
  Probability and statistics (Chapter 23)
  Homework 9
- Thursday, December 5:
  Review of the course

FINAL EXAM
- Tuesday, December 10, 7:00-10:00 PM