

PHY 5830 – CLASSICAL ELECTRODYNAMICS

COURSE INFORMATION

PHY 5830, CRN 45312

Term: Fall 2020

Classroom: HHS 113

Meeting days/time: TR 10:00-11:47 AM

Final Exam: TBA

Course (catalog) description: Review of electrostatics, magnetostatics, Maxwell's equations and electromagnetic waves. Relativistic description of particles, fields and interactions. Radiation by moving charges, bremsstrahlung, radiation damping, self fields. Formerly PHY 583. Recommended prerequisites: PHY 3720 or PHY 4720 or PHY 5520.

Prerequisites: Recommended prerequisites: PHY 3720 or PHY 4720 or PHY 5520.

Course format: On-campus meetings

PROFESSOR INFORMATION

Name: Dr. Vasyl Tyberkevych

Office location: HHS 274

My student hours (office hours) are T 12:00-2:00 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.

COVID-19 RELATED INFORMATION

- Due to social distancing requirements, personal meetings in my office are not possible now. If you have a question that cannot be resolved by email, we will meet online using Google Meet videoconference at <https://meet.google.com/grp-gmyn-fcf>. I will make every effort to be always available online during my office hours, but please send me an appointment request by email at least 10-15 min prior to the desired meeting time.
- In case on-campus lectures will be cancelled during the semester, the lectures will continue online using YuJa (<https://oakland.yuja.com>) videoconferencing and lecture capture system. Please make sure YuJa works properly on your laptop/computer.

LEARNING OUTCOMES

By the end of the course students will be able to:

- Apply Maxwell equations to various types of electrostatic, magnetostatic, and electrodynamic problems
- Formulate the electrostatic boundary value problem for an arbitrary charge distribution and different types of boundary conditions
- Solve the electrostatic boundary value problems using various mathematical techniques
- Find electrostatic energy corresponding to an arbitrary charge distribution
- Find capacitance for a system of ideal conducting surfaces
- Solve the magnetostatic boundary problems for vector potential
- Find magnetostatic energy corresponding to an arbitrary localized current distribution
- Find self- and mutual inductances for a system of current conductors
- Derive boundary conditions for electromagnetic fields at a boundary between two media
- Find energy and momentum corresponding to an arbitrary electromagnetic field
- Apply Poynting's theorem to find energy flow in a system of charged particles and electromagnetic fields
- Find plane electromagnetic wave solutions of the Maxwell equations
- Find normal modes of an electromagnetic waveguides and resonant cavities
- Find electromagnetic radiation of a localized source
- Mathematically describe scattering and diffraction of electromagnetic waves
- Describe electromagnetic fields in a Lorentz-invariant form
- Describe motion of a relativistic charged particle

TEXTBOOKS AND MATERIALS

TEXTBOOK

- J. D. Jackson, Classical Electrodynamics, 3rd edition, N. Y.: John Wiley & Sons, 1999
ISBN: 978-0-471-30932-1

MOODLE

- Some of the materials associated with class (e.g., lecture slides and exam problem solutions) will be disseminated through Moodle (moodle.oakland.edu)

ASSIGNMENTS

HOMEWORK $7 \times 3 \% =$ 21 %	HOME PROJECTS $2 \times 12 \% =$ 24 %	MIDTERM EXAM 27 %	FINAL EXAM 28 %
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HOMEWORK (21 %)

- There will be **7 homework assignments**, each worth **3 %** of the final grade
- Each assignment will consist of approximately 5 textbook problems and will be disseminated approximately 2 weeks before the due date
- The assignments are due **every second Tuesday**, starting from **Sep 15**, before beginning of the class (except the last assignment, which is due **Dec 3**)

HOME PROJECTS (24 %)

- There will be **2 home projects**, each worth **12 %** of the final grade
- Each home project will be a single, but rather difficult problem, which will require application of various advanced techniques for its solution. Home projects will be assigned approximately one month before due dates
- The home projects are due **Oct 27** (midterm exam date) and **Dec 3** (last lecture)

MIDTERM EXAM (27 %)

- Midterm exam will be carried out on **Oct 27** and is worth **27 %** of the final grade
- You may use the textbook for a limited time (up to 10 min) during the exam. You may also bring several (up to 5) letter-size sheets containing *hand written* formulas and notes. You may not share your notes with anyone else

FINAL EXAM (28 %)

- The final exam (worth **28 %** of the final grade) will follow the same rules as the midterm exam. The final exam will cover only the material after the midterm exam
- The date, time, and place of the final exam will be announced later

EXTRA CREDIT

- Possibilities for extra credit (up to **5 %** of the final grade) will be discussed during 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

GRADING SCALE

LETTER GRADE	MINIMUM %	NUMERICAL EQUIVALENT
A	95	4.0
A-	90	3.7
B+	85	3.3
B	80	3.0
B-	75	2.7
C+	70	2.3
C	65	2.0
C-	60	1.7
D+	55	1.3
D	50	1.0
F	< 50	0.0

USING MOODLE AND OTHER TECHNOLOGIES

USING MOODLE

- Some of the materials associated with class will be disseminated through Moodle (e.g., lecture slides and 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](https://www.oakland.edu/stc/) (Link to Student Technology Center: <https://www.oakland.edu/stc/>).
- For general technology assistance, consult the [OU Help Desk](https://www.oakland.edu/helpdesk/) (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 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](#) for details. (Link to Student Code of Conduct: <https://www.oakland.edu/deanofstudents/student-code-of-conduct/>)

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). 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 of Disability Support Services website. (Link to Disability Support Services website: <https://www.oakland.edu/dss/>)

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 by clicking on Student Health & Safety Resources. (URL: <http://www.oakland.edu/deanofstudents>)

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: <https://www.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. (<https://www.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](#) (even if you think it won't be necessary), and consult the [Drop or Not Guide](#) to make a well-informed decision before dropping a course. (<https://www.oakland.edu/registrar/registration/dropornot/>)

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	Day	Date	Lecture Topics	Textbook	HW/HP
1	R	Sep 3	Course overview. Introduction	Intro, Ch. 1	
2	T	Sep 8	Electrostatics. Gauss's law. Scalar potential	Ch. 1	
	R	Sep 10	Electrostatics. Electrostatic energy. Capacitance	Ch. 1	
3	T	Sep 15	Boundary-value problems in electrostatics. Method of images	Ch. 1 & 2	HW 1
	R	Sep 17	Boundary-value problems in electrostatics. Green function. Orthogonal functions and series expansion	Ch. 2	
4	T	Sep 22	Laplace equation in rectangular coordinates. Separation of variables	Ch. 2	
	R	Sep 24	Laplace equation in spherical coordinates. Spherical harmonics	Ch. 3	
5	T	Sep 29	Laplace equation in cylindrical coordinates. Bessel functions	Ch. 3	HW 2
	R	Oct 1	Multipole expansion. Dielectrics	Ch. 4	
6	T	Oct 6	<i>Review lecture</i>		
	R	Oct 8	Magnetostatics. Biot-Savart law. Faraday law. Vector potential	Ch. 5	
7	T	Oct 13	Faraday law. Inductance. Energy of magnetic field	Ch. 5	HW 3
	R	Oct 15	Maxwell equations. Scalar and vector potentials. Gauge transformations	Ch. 6	
8	T	Oct 20	Green function for the wave equation. Conservation laws. Poynting theorem	Ch. 6	
	R	Oct 22	<i>Review lecture</i>		
9	T	Oct 27	Midterm exam	Ch. 1-6	HW 4, HP 1
	R	Oct 29	Plane electromagnetic waves	Ch. 7	
10	T	Nov 3	Reflection and refraction of waves	Ch. 7	
	R	Nov 5	Waveguides. Modes in a rectangular waveguide	Ch. 8	
11	T	Nov 10	Resonant cavities. Modes of a rectangular cavity	Ch. 8	HW 5

Week	Day	Date	Lecture Topics	Textbook	HW/HP
	R	Nov 12	Radiation of a localized source. Electric dipole radiation	Ch. 9	
12	T	Nov 17	Magnetodipolar radiation. Multipole expansion for localized source	Ch. 9	
	R	Nov 19	Scattering and diffraction	Ch. 10	
13	T	Nov 24	Elements of special theory of relativity	Ch. 11	HW 6
	R	Nov 26	<i>No classes – Thanksgiving recess</i>		
14	T	Dec 1	Motion of relativistic particles	Ch. 12-16 (parts)	
	R	Dec 3	Motion of relativistic particles	Ch. 12-16 (parts)	HW 7, HP 2
15		TBA	<i>Final Exam</i>	Ch. 7-11, 12-16	