# PHYS 1220/1320: Physics II –E&M and Thermodynamics Sum 25

**General Information**

Office E-mail

Instructor: Rudi Michalak, 215 PS rudim@uwyo.edu

TAs: N/A

**Office hours/Zoom Office hrs:** F 10:10-11:45 / tbd

*This course fulfils university program requirement USP03 ‘SP’ and USP2015 ‘PN’ for 4 credit hours*

Lecture & discussion: see schedule MTWRF 210- 400 Enzi 195

synchronous Zoom runs during in-person lecture; video posted same day in Wyocourses under Announcements for asynchronous use; attendance only counts for synchronous attendance for the full lecture

Text: Young Freedman University Physics 5th ed,

**via inclusive access** in Wyocourses

*Supplementary Reading Suggestions: On your request I am happy to name some useful texts, which adopt different teaching approaches than Young/Freedman.*

**Course Content and Course Pre-Requisites:**

This course is an introduction to the physical phenomena of temperature and electric charge. We will approach the material from theoretical and applied angles. Our course is part of the suite of ***experimental physics course***s. Consequently, significant emphasis is put on developing laboratory skills. Most physics courses differ from engineering courses in that *we pay much more attention**to* ***where laws and equations come from*** (‘derive’ them) and what their ***range of applicability*** is. ALL laws of physics have significant limitations as to when and where they apply. It is important for any deeper understanding that the student develops an insight into these aspects of physical law.

We will use concepts previously learned in Mechanics, like Newton’s Laws and conservation laws. With them and with new empirical observations we will explore how the presence of electric charge causes the numerous phenomena of electricity and magnetism.

We will learn about the rules, which govern circuitry. As we go along, we will discover fundamental laws called the Maxwell Equations, which allow us to describe all of these phenomena and unite the concepts of magnetism and electricity as two aspects of the same thing: electric charge and its motion. We will learn to describe electromagnetic phenomena as the results of the propagation of electromagnetic waves.

Then we will study new phenomena, which occur when temperature changes, e.g. heat transport, specific heat, and the fundamental laws of thermodynamics. These new laws will add to our understanding of all other fields of physics in that they provide a direction in which natural processes spontaneously progress.

*A working knowledge of calculus is required. Calculus II is a pre-requisite for this course! For the summer term, I* ***waive the Calculus co-and pre-reqs*** *as long as the student qualifies to take those courses (has passed the pre-cursor courses). Note, that the systematic of the science of physics does not follow the systematic of mathematics! We will have to use concepts like differentiation, integration, and vectors from week one on. Also, good success in this course is unlikely without a solid grasp of algebra, geometry, and trigonometry.*

All of the following information is ***tentative,*** and I reserve the right to change any of it as seems necessary to keep the class average on course. If such changes are made, they will be announced in class. It is your responsibility to stay informed and to catch up with anything you may have missed in class.

**Lecture**

Our course consists of a large amount of information and much of it is new to many students. I have arranged the content into seven major sections:

***Electricity***- the phenomenon of electrical charge, field, force, energy, and electric potential;

***Basic Circuitry-*** resistor and capacitor networks; fundamentals of time dependence in circuits

***Magnetostatics***- surprising effects of moving charges, right hand rule frenzy

***Magnetism-*** more involved consequences of motion of charges

***Electrodynamics***- the Maxwell Equations describe how magnetic fields arise out of changing electric fields and vice versa; electromagnetic waves;

***Thermal physics***- temperature and heat, heat transport, thermal phenomena;

***Four Laws of Thermodynamics-*** heat engines, phase changes and phase diagrams, th.dyn. potentials and partial derivatives

Each topic by itself is not terribly difficult. However, for many students much of the material is new and our brain has only so much capacity to deal with new things in a short amount of time. To help you with that aspect of learning, I break lecture down into actual lecture blocks and interactive activities. Some activities deal with videos, others with web applets (bring an internet device to class, if you can), others with in-class demonstrations, and yet others with active problem solving. They are designed to clear your brain’s short term memory and make it susceptible again. This help will only be effective, if you actively participate in the assignments.

*Some technical notes:*

The lecture will in part be presented in power point and in part on the white board. Demonstrations, videos, and web-applets will be used wherever helpful in illustrating a complex or new phenomenon or principle.

You need to write down the information on the white board as your lecture notes, or it will be lost. My power points on the webpage are printer friendly and help you to keep up with the material on the white board. You are expected to take notes about videos, applets, and demonstrations. The content of each may be part of exam questions.

I employ group work techniques during lecture. Our department’s record, as well as national studies, has shown that the use of modern teaching techniques deepens understanding and reliably improves the outcome of standardized tests of knowledge retention.

Our brain has only so much capacity to deal with new things in a short amount of time. To help you with that aspect of learning, I break lecture down into actual lecture blocks and interactive activities. Some activities deal with videos, others with web applets (bring an internet device to class, if you can), others with in-class demonstrations and twenty minutes hands-on experiments taken from labs, and yet others with active problem solving. They are designed to clear your brain’s short term memory and make it susceptible again. This help will only be effective, if you actively participate in the assignments.

## Discussion Sessions and Laboratory

Discussions are integrated with lecture sessions (studio style).

***Participation in all laboratories is mandatory*** for the successful completion of this course. There is no time for makeup labs. Labs are often on W but there are some exceptions. Each pair of students submits a **streamlined single lab report**. The report consists of:

*The lab book* with original data and pertinent information necessary to reproduce the result*s.*

*A summary statement about the main result(s) within error.*

*Tables with the main data analysis.*

*Graphs with proper error bars and appropriate fitting curves.*

*A self-evaluation of your own pre lab answers (pre lab submitted together with the report).*

**Take note of these categories as points for reports are awarded according to this list only.**

A ‘good’ lab group consists of two students, who share in all aspects of the experimental work, the note taking, and who come reasonably prepared for the tasks. Plan ahead to work at least half an hour on the lab manual before lab, and, before the first lab, work through the data and error treatment sections.

**Exams**

The exams will contain both quantitative and conceptual problems. ***The exams will be closed book and closed notes***. I will provide you with a formula sheet. You can see it in the lab manual. The use of any electronic equipment is not permitted during the exam. Calculators with no formulas stored on them are acceptable.

All exams are mandatory and none of the grades will be dropped or replaced. The exams will be held at the following times and cover the following chapters in *Young & Freedman*:

Exam 1, midterm Zoom – tbd Chapter 21-26

Exam 2, final Zoom – tbd Chapter 27-30, 17-20

**Homework**

We use the Mastering Physics online homework system (see Wyocourses). The online homework must be submitted by each student individually but you are *allowed to work together on* *the solution as long as everyone contributes an equal share of work and contributes* ***to all*** *problems*.

The deadlines for homework are indicated in the tentative schedule below and on the Mastering website. They are subject to change *as announced during lecture and in Mastering*. Be advised not to work last minute on the online submissions. The system tends to be busy at times and the internet connection could be down. It is your responsibility to work and submit before the deadline. I set the online hw system up to accept post deadline submissions for a penalty. The penalty builds up over some time. The system will close for late submission on the Saturday after the final exam at 5pm.

In summer term, everything happens very fast and it is difficult to come back when one misses deadlines. It is not impossible, but it needs a very focussed effort that goes along with work for the next deadline. To give you a bit more leeway with planning, I set HW deadlines only for the weekends. That would amount to only 6 hw rather than the usual 12. So, I set two hw deadlines for each weekend of subsequent chapters. That way, you can choose when you work on the various parts of hw. You should start to work when you are ready and not wait for the deadline. Use the flexibility to shift your work load to when your schedule allows.

Since this is a new system with a different approach, I will monitor how it goes and reserve the right to change the approach if results are not what one expects or if work loads turn out to be not manageable.

**Grading**

The average final grade in the course has historically been a C+/B- (GPA ~ 2.6). This is close to the ten year average of College of A&S and College of Engineering grade averages for 1000 and 2000 level classes (GPA 2.6).

Details of grading (subject to revision):

Exams: 2 (60%)

Homework: 6 double (20%)

Labs: 5 reports (20%)

*Three lecture absences are excused without need to document reasons.*

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**100%**

**Scale:**

A > 90.0%

B 80.0-89.99%

C 65.0-79.99%

D 52.5-65.0%

F < 52.5%

I reserve the right to curve the final grade and each exam.

I will discuss grades for hw, labs, exams, and all other grades *only for up to one week after* the work has been handed back to class (not one week after you have collected it).

**General requirements and expectations for the course:**

**Required texts, readings, and special tools or materials:**

Young Freedman, inclusive access

Michalak, Lab Manual

**General requirements and expectations for the course:**

Attendance is required. Absences in lab result in failing the course if no makeup time can be arranged.

Late work is accepted for a grade penalty.

Students are expected to attend and participate in all activities, labs, and lectures.

Grading Scale and Grading Policies:

90-80-65-52.5 scale.

Classroom Behaviour Policy:

Attend every lecture and discussion, and exam. Attend every lab unless you transferred lab from a previous course. Closed book, no notes except during lecture. You are expected to work in groups or alone as requested and to hand work in by the specified deadlines. You shall come prepared for lecture and lab by reading through the appropriate material ahead of time. You are expected not to disrupt class.

No electronic devices other than for classroom advised internet access.

No taping of any kind without prior permission.

No unrelated activities that interrupt class.

**Classroom Statement on Diversity:** “The University of Wyoming values an educational environment that is diverse, equitable, and inclusive. The diversity that students and faculty bring to class, including age, country of origin, culture, disability, economic class, ethnicity, gender identity, immigration status, linguistic, political affiliation, race, religion, sexual orientation, veteran status, worldview, and other social and cultural diversity is valued, respected, and considered a resource for learning. “

**Disability Support**:

*The University of Wyoming is committed to providing equitable access to learning opportunities for all students.* *If you have a disability, including but not limited to physical, learning, sensory or psychological disabilities, and would like to request accommodations in this course due to your disability, , please register with and provide documentation of your disability as soon as possible to Disability Support Services (DSS), Room 128 Knight Hall. You may also contact DSS at (307) 766-3073 or*[*udss@uwyo.edu.*](mailto:udss@uwyo.edu)*It is in the student’s best interest to request accommodations within the first week of classes, understanding that accommodations are not retroactive. Visit the DSS website for more information at:*[*www.uwyo.edu/udss*](http://www.uwyo.edu/udss)

**Academic Dishonesty Policies**:

*Academic dishonesty will not be tolerated in this class. Cases of academic dishonesty will be treated in accordance with UW Regulation 2-114. The penalties for academic dishonesty can include, at my discretion, an “F” on an exam, an “F” on the class component exercise, and/or an “F” in the entire course. Academic dishonesty means anything that represents someone else’s ideas as your own without attribution. It is intellectual theft – stealing - and includes (but is not limited to) unapproved assistance on examinations, plagiarism (use of any amount of another person’s writings, blog posts, publications, and other materials without attributing that material to that person with citations), or fabrication of referenced information. Facilitation of another person’s academic dishonesty is also considered academic dishonesty and will be treated identically.*

**Duty to Report:**

*While I want you to feel comfortable coming to me with issues you may be struggling with or concerns you may be having, please be aware that I have some reporting requirements that are part of my job description at UW.*

*For example, if you inform me of an issue of sexual harassment, sexual assault, or discrimination I will keep the information as private as I can, but I am required to bring it to the attention of the institution’s Title IX Coordinator. If you would like to talk to those offices directly, you can contact Equal Opportunity Report and Response (Bureau of Mines Room 319, 766-5200,* [*report-it@uwyo.edu*](mailto:report-it@uwyo.edu)*,* [*www.uwyo.edu/reportit*](http://www.uwyo.edu/reportit)*). Additionally, you can also report incidents or complaints to the UW Police Department. You can also get support at the STOP Violence program (*[*stopviolence@uwyo.edu*](mailto:stopviolence@uwyo.edu)*,* [*www.uwyo.edu/stop*](http://www.uwyo.edu/stop)*, 766-3296) (or SAFE Project (*[*www.safeproject.org*](http://www.safeproject.org/)*,* [*campus@safeproject.org*](mailto:campus@safeproject.org)*, 766-3434, 24-Hour hotline: 745-3556).*

*Another common example is if you are struggling with an issue that may be traumatic or unusual stress. I will likely inform the Dean of Students Office or Counseling Center. If you would like to reach out directly to them for assistance, you can contact them using the info below or going to* [*www.uwyo.edu/dos/uwyocares*](http://www.uwyo.edu/dos/uwyocares)*.*

*Finally, know that if, for some reason, our interaction involves a disruptive behavior or potential violation of policy, I inform the Dean of Students, even when you and I may have reached an informal resolution to the incident. The purpose of this is to keep the Dean apprised of any behaviors and what was done to resolve them. All of these provisions are also required of me by university regulations.*

**Substantive changes to syllabus**

*All deadlines, requirements, and course structure are subject to change if deemed necessary by the instructor. Students will be notified verbally in class, on our WyoCourses page announcement, or via email of these changes.*

*Circumstances may alter the reading and/or test schedules. You are required to check WyoCourses and your email at least twice a week a day before lab day.*

**Student Resources:**

*DISABILITY SUPPORT SERVICES:* [*udss@uwyo.edu*](mailto:udss@uwyo.edu)*, 766-3073, 128 Knight Hall,* [*www.uwyo.edu/udss*](http://www.uwyo.edu/udss)

*COUNSELING CENTER:* [*uccstaff@uwyo.edu*](mailto:uccstaff@uwyo.edu)*, 766-2187, 766-8989 (After hours), 341 Knight Hall,* [*www.uwyo.edu/ucc*](http://www.uwyo.edu/ucc)

*ACADEMIC AFFAIRS: 766-4286, 312 Old Main,* [*www.uwyo.edu/acadaffairs*](http://www.uwyo.edu/acadaffairs)

*DEAN OF STUDENTS OFFICE:* [*dos@uwyo.edu*](mailto:dos@uwyo.edu)*, 766-3296, 128 Knight Hall,* [*www.uwyo.edu/dos*](http://www.uwyo.edu/dos)

*UW POLICE DEPARTMENT:* [*uwpd@uwyo.edu*](mailto:uwpd@uwyo.edu)*, 766-5179, 1426 E Flint St,* [*www.uwyo.edu/uwpd*](http://www.uwyo.edu/uwpd)

*STUDENT CODE OF CONDUCT WEBSITE:* [*www.uwyo.edu/dos/conduct*](http://www.uwyo.edu/dos/conduct)

Tentative Schedule Phys 1220 Summer Course ‘25

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | M  210-400 | T  210-400 | W  210-400 | R  210-400 | F  210-400  hw deadlines |
| May 26-30 | -  *Memorial day* | Intro  E1 | E2  E3 | E4  prelab  HW0, 11pm | E5  E6  HW1/2, Sun 11pm |
| Jun 2–6 | E7  E8 | E9  E10 | Expt (I)  Field Lines | EC1  EC2 | EC3  EC4  HW3/4, Sun 11pm |
| Jun 9 – 13 | EC5  EC6 | EC7  EC8 | Expt (II)  R networks | EC9  EC10  HW5/6,Thu 11pm | M1  M2  *5pm midterm* |
| Jun 16 -20 | M3  M4 | M5  M6 | Expt (III)  C charging | M7  M8 | M9  M10  HW7/8, Sun 11pm |
| Jun 23 -27 | M11  M12 | M13  M14 | Expt (IV)  B Wires | T1  T2 | T3  T4  HW9/10,Sun11pm |
| Jun 30- Jul3 | T5  T6 | T7  T8 | Expt (V)  Th Exp/ Spec Heat | T9  T10  HW11/12,Sun11pm | 4th of July  *5pm final* |

E – Electrostatics EC – Circuitry M – Magnetostatics T- Thermal Physics

**Tentative lecture plan (use reading guide on webpage to come prepared):**

**Intro Syllabus,**

**E1 F, electrostatic force general, induction, F-U-E-V overview**

**E2 F, point charges**

**E3 E, electric field general and point charges**

**E4 F, E examples**

**E5 Gauss’s Law**

**E6 Gauss’s Law, examples**

**E7 Gauss’s Law, examples**

**E8 U, V – electric potential V**

**E9 U, V – electric potential (energy)**

**E10 U, V – electric potential (energy)**

**EC1 current and resistivity**

**EC2 current and resistivity, Ohm’s law**

**EC3 networks, parallel and series**

**EC4 networks, Kirchhoff rules**

**EC5 capacitors networks**

**EC6 capacitor networks, energy**

**EC7 special capacitors, charging/discharging C**

**EC8 RC circuits**

**EC9 flex**

**EC10 flex**

**M1 motion of charges**

**M2 magnetic forces**

**M3 Biot-Savart law**

**M4 buffer day (fill in loose ends)**

**M5 current carrying wires**

**M6 Ampere’s law**

**M7 Faraday’s law**

**M8 Lenz’s law,**

**M9 Lenz’s law, motional emf**

**M10 magnetic induction, RL, LC circuits**

**M11 magnetic induction, RL, LC circuits**

**M12 LRC circuits and resonance**

**M13 AC circuits**

**M14 em waves**

**T1 temperature, heat, thermometers**

**T2 thermal conduction, expansion; specific heat**

**T3 specific heat, state equations**

**T4 kinetic gas theory**

**T5 phase diagrams (pV and pT)**

**T6 state variables, first law**

**T7 pV diagram calculus**

**T8 pV diagram calculus, examples**

**T9 heat capacity, second law**

**T10 second law, engines, entropy**