

# Advising Notes for Physics Majors

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We put together these notes to help you get the most out of your major, especially when planning your courses. Please look over them carefully, as failure to follow some of these guidelines may prevent you from taking desired courses or even from graduating on time. For a full listing of the requirements for the Physics major, see the UC Merced Academic [Catalog](#).

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## 1 Welcome to the Physics Program

Physics is the study of nature at its most fundamental. Its scope covers everything from the tiniest particles of matter—such as atoms, electrons and quarks—to the structure of the entire universe, encompassing innumerable galaxies and stars. At UC Merced, our areas of expertise lie in Astrophysics;

Quantum Science and Technology (including Condensed Matter Physics and Atomic, Molecular, and Optical Physics); Computational Physics; Biological and Soft Matter Physics; Nanosciences and Condensed Matter Physics; and Solar and Energy Sciences.

## 1.1 Emphases

The established emphasis tracks are: Astrophysics; Biophysics and Soft Matter; Computation and Data Science; Engineering and Applied Physics; Mathematical and Computational Physics; and Quantum Science and Technology. Students may also propose and design their own customized emphasis tracks, with the assistance of their faculty advisors. Typically, the track includes the three upper division physics electives and culminates with the student's senior thesis (PHYS 195/PHYS 196) or capstone (ENGR 193/ENGR 194). A student may also choose not to participate in the track program at all, although the senior thesis and two physics electives are still degree requirements. See Section 3.

## 1.2 Advising

First-year students receive academic advising through the [Bobcat Advising Center](#). Afterward, you'll be working the physics academic advisor, listed in Section 6 or check [Natural Sciences Advising](#). All physics majors are also assigned a physics faculty advisor. Your *physics faculty advisor* offers you disciplinary expertise on course content; advice for timing courses; and advice for pursuing research, internships, and a physics-related career. Your *academic advisor* offers guidance on meeting all campus, School, and Major requirements for graduation. We recommend students meet with their physics advisor before enrolling in spring courses. Majors are **required** to meet with their physics faculty advisor before enrolling in Fall courses; a hold is placed on your registration for fall course until you meet with your faculty advisor.

When these notes are distributed via the physics majors email list, you should also receive a list of physics faculty advisor assignments. If you cannot locate this, contact the physics undergraduate lead (see Section 6). Check this list to find your physics faculty advisor. All majors participate in research; once you have a research advisor, they typically also become your physics faculty advisor.

### 1.2.1 Timing for Meeting with your Physics Advisor

The course schedule is usually available a month before registration opens. In general, registration for spring classes opens in early November, and early April for fall classes. Contact your physics faculty advisor for a meeting well before registration opens. Faculty schedules are busy, so it's in your best interest to schedule an appointment with as much advance notice as possible. If your physics advisor is on sabbatical, another faculty member will meet with you; check the list.

## 1.3 Registering for courses

You should register for your physics courses when your registration window opens. We're one of the smaller majors in the School of Natural Sciences. Although most of our upper-division courses have not reached maximum enrollment, there have been cases where a course has been cancelled

due to low enrollment because students assumed there were no consequences for waiting to enroll. For upper-division courses (100's), a minimum of 8 students needs to be enrolled to keep a course from getting cancelled. If a course is conjoined with a graduate course, (cross-listed with 200's, e.g. 180/280), the minimum enrollment is 4.

## 2 Notes by Year

### 2.1 General Considerations

The required number of electives for the major are the minimum needed to graduate. We highly recommend you take as many physics and math courses reasonably able to fit into your schedule. See the tables in Section 3 for information on when classes are offered and when you should take them. Starting research in your second or third year (rather than waiting until fourth year) is an additional way to prepare for graduate school and/or further immerse yourself in the field. If you're pursuing a physics emphasis, the timing of electives is important as they are currently offered every other year. We also encourage all majors to take advantage of summer internship opportunities and clubs such as the Society of Physics Students.

### 2.2 First Year

Enroll in the introductory physics (PHYS 8 and 9) and calculus sequence (MATH 21 and 22) as early as possible. PHYS 8 and 9 are the only physics courses offered every term, including the summer session. If you take PHYS 8 in the spring, you'll need to take PHYS 9 in the summer to stay on track; this can be done at UC Merced, or you can take an equivalent class at another institution such as your local community college. The School of Natural Sciences has an early progress policy that states all NatSci majors need to pass their first math and chemistry courses within their first year. If you're deciding between taking chemistry or physics in your first semester, take physics and save chemistry for later!

Ideally, you should complete these 4 math and physics courses during your first year so that there is no delay enrolling enrolling in PHYS 10 (Modern Physics), which is only offered in fall terms and requires MATH 24 as a pre-requisite. PHYS 10 is a pre-req for PHYS 137 (Quantum I), which is a pre-req for PHYS 138 (Quantum II), 144 (Modern Atomic, Molecular, and Optical Physics), 172 (Quantum Information Science), etc. All of our core upper-division courses are only offered in one semester each year; our electives are only offered one semester every *other* year. So timing is important. *Warning!* There have been cases where students have gotten permission to take PHYS 9 and 10 concurrently. MATH 22 is a co-requisite for PHYS 9, and MATH 24 is a co-requisite for PHYS 10. However, MATH 22 is a *pre-requisite* for MATH 24, which could prevent you from taking PHYS 9 and PHYS 10 concurrently.

Get to know your fellow physics majors as well as other fans of physics by checking out the Society of Physics Students (see Section 5.1). Fellow students can give you great advice on classes and navigating your way at UC Merced. Pay attention to emails from the undergrad lead; that's how

we make announcements about social events, exciting seminar speakers, internship opportunities, on-campus job opportunities, etc.

## 2.3 Second Year

Take PHYS 10 in second year if at all possible. It is in the fall currently but we are switching to spring since many students are not ready to take it yet in the fall of their second year; there will be a transition year in which it is offered both semesters. PHYS 10 is a pre-requisite for PHYS 137 (Quantum I) and other classes. Postponing PHYS 10 may set you back a year and increase your time to graduation. By the end of your second year, you should have completed your core calculus sequence: MATH 21, 22, 23, and 24.

Consider starting research with a faculty member (see Section 5.2.1) or a summer internship (see Section 5.2.4). For those students using PHYS 195/196: Senior Research & Thesis as their capstone, the best theses and research presentations coincide with more time doing research with a faculty member. Doing research with faculty during the academic year and internships at other places during the summer is common in our program. Research with faculty and summer internships are great ways to explore whether a research-oriented career and possibly graduate school would be a good fit for you.

Speaking of careers, it's never too early to prepare for life after UC Merced. The Center for Career and Professional Advancement ([CCPA](#)) offers workshops, hosts information sessions and panels with employers, career assessments, help on resumes and cover letters, in addition to a number of other resources. The Society of Physics Students offers the [Careers Toolbox](#) to help physics majors succeed landing a job in the workforce. Did you know that approximately 35% of physics bachelors graduates work in the engineering field and 27% work in Computer or Information Systems?<sup>1</sup>

If you love physics and possibly foresee a career in engineering, consider enrolling in ENGR 97: Engineering Service Learning, a 1-2 unit course where you'll join a multi-disciplinary team of students to work with community organizations on real-world problems. Also, consider the Engineering and Applied Physics emphasis.

## 2.4 Third Year

It's time to focus on what electives you want to take over the next two years. Our electives are offered every other year. We're working towards a standard schedule to help you plan, but we're also working to add additional electives (see Section 3).

It's a good time to explore options for after graduation. Starting or continuing research with a faculty member—in anticipation of doing the PHYS 195/196 capstone—aligns with research-oriented careers and preparing for graduate school. Participating in Engineering Service Learning opportunities—in anticipation of the ENGR 193/194 capstone—prepares you to for an engineering-related career track. Don't hesitate to explore both options to find out what truly interests you. Check out the [weekly](#)

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<sup>1</sup><https://www.aip.org/statistics>

[physics colloquium](#) featuring presentations about different topics in physics research by scientists from other places visiting UC Merced, Friday mornings (listed as PHYS 293 in course catalog, but no need to be registered to attend), and PHYS 251 (Introduction to Graduate Research) which features presentations by UC Merced physics faculty about their research aimed at first-year graduate students (again, no need to be registered to attend). Towards the end of the spring semester, one of the colloquium sessions is devoted to PHYS 196 presentations of senior thesis research, so you can see what your peers have been up to and what awaits you next year. You can do research not only with core physics faculty, but also others doing physics-related research in other departments, e.g. the affiliated faculty of the physics graduate group; see the [website faculty listing](#). You can also do senior thesis based on work in the summer off-campus at an REU or similar program, with a nominal faculty advisor here to help with final data analysis and thesis-writing. Check out the annual Innovate to Grow event from the School of Engineering (end of spring semester) which showcases the work students have done in engineering capstone, if you want to see what that option is like.

Timing for finishing up core courses: If you're considering a PhD program in physics, you should look at taking the Physics GRE in the fall of your fourth year, although many programs have stopped requiring this exam (check ones you may be interested in to be sure); to be well prepared, try to complete your core courses in your third year, as there are some questions on upper-division and elective topics. The more physics you take in your third year, the better prepared you will be!

Research: Get started engaging in research with faculty *early*. We strongly recommend starting by the summer between your third and fourth years. **Before the end of your third year**, make sure that you have found a faculty member with whom you can complete your senior thesis if using PHYS 195/196 as your capstone (even if you plan on starting research in the fall of your fourth year). For graduate school applications, research experience is very helpful so you can discuss it in your statement of purpose, show your accomplishments, and also get a better idea of whether research is how you want to spend the next 5-6 years, and what subfield(s) of physics you are interested in.

Timing for electives: Especially if you have an emphasis, pay attention to the timing of electives that satisfy it as well as necessary pre-requisites. Our schedule is designed to offer every elective every two years. Explore your interests via electives. For PhD applications, it is not essential to have done research in the same subfield in which you would like to pursue your PhD, but it certainly helps, and it is important to help get an idea of your interests.

## 2.5 Fourth Year

The capstone experience is a year-long sequence typically in the fourth year. Thus far, it has been satisfied with PHYS 195/196: Senior Research & Thesis. Students can satisfy the capstone experience with ENGR 193/194: Engineering Capstone Design I/II. If your post-UC Merced plans include graduate school, we recommend PHYS 195/196. If you are more interested in an engineering career, we recommend the Engineering Capstone Design.

*PHYS 195/196: Senior Research & Thesis.* Typically, students sign up for 2 units of research each semester with their thesis advisor. Senior year research is broken up into two different course num-

bers because your thesis is due at the end of PHYS 196. Also, these four units of research must be taken for a letter grade. Note that PHYS 195 is a pre-requisite for PHYS 196 and must be taken before. Typically PHYS 195 is taken in the fall and PHYS 196 in the spring, but you can also take PHYS 196 in the fall if you are graduating in fall semester. PHYS 195 is just doing research with your faculty advisor. PHYS 196 is research with your advisor but also a weekly class, guiding you through the preparation of your written thesis and presentation. It culminates in a presentation to the department during the weekly colloquium at the end of the spring semester.

*ENGR 193/194: Engineering Capstone Design I/II.* The Engineering Capstone is a 5-unit sequence.

## 2.6 Beyond the Fourth Year

There are a number of reasons why students may graduate after their fourth year. Please work with your academic and physics advisors to plan for graduating. It may also be an opportunity for you to take additional electives, pick up a minor, or experience an additional summer internship.

## 2.7 After UC Merced

Take the next step by researching graduate programs, professional programs, and/or job opportunities as soon as you begin taking upper-division course. Graduate applications are typically due in late fall. Take a look at some of the [information and advice](#) provided from our own PhD program. You are welcome to apply to our own program, but also the advice there is generally true for other US physics PhD programs too. Career Services has a number of resources, including a STEM Career Specialist, to help prepare for the job market. Take a look at our [alumni listing](#) to see what your peers have been going on to do.

# 3 Physics Courses: Timing and Additional Information

Table 1 shows when our courses are offered, projected into the coming years. Since we are a small but growing major, our classes are not offered every term. Required (aka Core) courses are offered every year. Electives are generally offered once every two years. We're working to offer a reliable schedule of electives so that students can better plan when to take electives, especially those that are needed for an emphasis.

**Minimum enrollment** It's important to enroll in your physics courses early. For lower-division courses (course numbers less than 100), 12 students must be enrolled for a course to be offered. For an upper-division course, the minimum number is 8. For a course conjoined with a graduate course (e.g. PHYS 141/241), 4 students must be enrolled. There are cases where a course that does not meet minimum enrollment may still be offered. For example, PHYS 196: Senior Thesis is a core course; it is offered every fall and spring term. An elective necessary for an emphasis requirement for students to graduate may still be offered. Electives that are not required for an elective are likely to be cancelled if enrolled is too low.

**PHYS 10 labs** The labs occur approximately every other week and last 6 hours. This allows us to offer multiple lab sessions without the previous section interfering with a following section's lab setups.

**PHYS 108: Thermodynamics** Multivariable calculus (MATH 24) is strongly recommended as a pre- or co-requisite for Phys 108.

**PHYS 195 & 196: Senior Research & Thesis** To enroll in either PHYS 195 or PHYS 196, fill out an [Independent Study Form](#).

- If you are doing research with a faculty member outside of Physics, contact the Undergraduate Physics Lead so that your advisor can have a section listed in the course and you get the proper credit for the course. (This often comes up with students doing a double-major and/or a custom emphasis.)
- Note that PHYS 195 is a pre-requisite to enroll in PHYS 196. The Physics department is no longer approving exceptions to co-enroll in PHYS 195 and 196.
- If you make arrangements with your research advisor to take PHYS 196 during the summer there is no seminar component; it is recommended you take PHYS 196 during the fall or spring semester.

## 4 Administrative Considerations

**Hold on Registration** To ensure you meet with your physics faculty advisor before enrolling for Fall courses, in Spring semester there is a hold placed on your registration. This is lifted only after meeting with your physics advisor. Your physics faculty advisor fills out an online form and the registration hold is lifted within one business day.

**General Catalog** A student is subject to the policies in the [General Catalog](#) in effect when they initially enroll. Through that link, you can access the current and archived copies of the Catalog. Students may also petition to adopt the policies in a newer catalog. *If possible, we recommend that students adopt changes made to the physics program.* Contact your physics and academic advisor if you have questions about adopting changes.

**Requirements for the Physics Major** The requirements for the major as well as the various emphasis tracks are listed in the General Catalog. Sample plans of study are attached at the end of these advising notes.

**Early Progress Policy** Any Natural Sciences major must pass the first course in the Math and Chemistry sequences—MATH 005 (or MATH 011 or MATH 021) and CHEM 001 (or CHEM 002)—prior to the start of their third regular (Fall/Spring) semester. Any student failing to do so will be moved to undeclared status. Please see [Natural Sciences Advising](#) or your academic advisor if you have questions. **Understand that this does NOT specify that you must take Chemistry your first semester at UC Merced. If you're deciding between Physics 8 and Chemistry for the fall term, we advise taking Physics 8 in the fall and saving Chemistry for the spring term.**

Table 1: *Tentative* Schedule of Physics Courses, projected through Academic year 2024-2025. Core courses are offered every year and marked with an ‘X’ to indicate the term offered. Also shown are recommendations for the year to take the course—based on a 4-year plan. Electives are offered every other year in the same term. The emphasis is indicated, if applicable. Pre = Pre-requisite courses, Co = co-requisite courses, and Rec = courses recommended as prerequisites. P=PHYS, M = MATH, C = CHEM

Core Courses	Pre, (Co), [Rec]	F	S	Year	Notes
P008, 8L <sup>1</sup> : Intro I	(M21)	X	X	1st	
P009, 9L <sup>1</sup> : Intro II	P8, (M22)	X	X	1st	
P010: Intro III	(P9) <sup>3</sup> , (M24)	F23	S24?	2nd	moving from F to S, perhaps in 2023-2024
P105: Mechanics	P8, (M23, M24)		X	2nd	
P108: Thermo	P9, [M24]	X		2nd <sup>4</sup> or 3rd	
P110: E&M I	P9, M23	X		3rd or 4th	
P115: E&M II	P110		X	3rd or 4th	
P126: Sp. Relativity mini	P9, [P110]		X	2nd	
P137: Quantum I	P10, M23, M24	X		3rd or 4th	
P138: Quantum II (mini)	P137		X	3rd or 4th	
P160: Modern Lab	P10		X	3rd	
P195 <sup>1</sup> : Ugrad Research	3rd/4th year student	X	X	3rd or 4th	or ENGR 193
P196: Thesis Research	P195	X	X	4th	or ENGR 194
Electives		F	S	Year	Emphasis
P095 <sup>1</sup> : Ugrad Research	1st/2nd year student	X	X		
P104: Biophysics	P8, P9	F24, F26		Even years	Bio/soft
P109: Soft Matter	P108		S23, S25	Odd years	Bio/soft, Eng/appl
P112/212: Stat. Mech <sup>5</sup>	P108	X	X		Astro, Bio/soft, QST
P116: Math. Methods	P9, M23, M24	F23, F25		Odd years	Astro, Math/comp
P121: Cosmology	(M23)		S24, S26	Even years	Astro
P123: Stellar Struct	P8	F24, F26		Even years	Astro
P127: Machine Learning Astro	P9, M32	F23, F25		Even years	Astro, Comp/data, Eng/appl, Math/comp
P141: Condensed Matter	(P137)	F23, F25		Odd years	QST, Eng/appl
P144: Modern AMO	P137		S24, S26	Odd years	QST
P148: Modern Optics	P9, M23, M24	F24, F26		Even years	QST
P172: Quantum Info. Sci.	P137	F24, F26		Even years	QST, Eng/appl
P180: Non-Linear Dyn.	P8, M23, M24, [P105]		S23, S25	Odd years	Astro, Math/comp
P181: Comput. Phys.	P10, CS, M23, M24, [P116]	F24, F26		Even years	All emphases
P192: Special Topics	P9	varies	varies	varies	Topic varies

<sup>1</sup> Offered during summer session as well.

<sup>3</sup> You may take PHYS 9 and 10 concurrently, but see the **Warning** under First Year. If possible, it is better to take PHYS 9 or its equivalent over the summer.

<sup>4</sup> Preferred.

<sup>5</sup> Currently P112 is not being offered, so sign up for P212 (graduate).



**Normal Progress to Degree** UC Merced undergraduate degree programs are designed to be completed in eight semesters or four academic years. (Summer terms are not included in the semester count.) To meet the normal progress requirement, undergraduate students are expected to enroll in and pass an average of 15 units per semester, completing the 120 units necessary for graduation in four years. An extension of enrollment beyond nine semesters requires the approval of the student's School.

## 5 Beyond Classes

### 5.1 SPS: Society of Physics Students

The SPS Chapter #0922 holds weekly meetings, study sessions, organizes outreach events, and works on various projects throughout the academic year. We encourage all majors to check it out and meet fellow students also interested in physics. Find more information on the [physics website about SPS](#). There is also an Astronomy Club being revived, and a [Women in Physics](#) group.

### 5.2 Research

Physics is more than taking classes. Research allows you to explore a specialization in detail. We encourage students to engage in research before their senior year and there are multiple options. Below are the most common pathways our majors have used to get undergraduate research experience. There is also some information on [our webpage](#).

#### 5.2.1 Research with Physics Faculty

Doing research with a faculty member is a great opportunity for all our majors, not just those choosing the PHYS 195/196 capstone. To find a faculty member with whom to work, we recommend looking at the [list of faculty members by research area](#) with their lab websites linked, to learn about their research areas. After identifying a couple of faculty members whose research interest you, introduce yourself in an email. Ask about research opportunities within their lab. You can also ask if they have other undergraduates doing research in the lab to get a peer's perspective on the experience. You can ask to attend a group meeting and/or visit the lab to find out if it would be a good fit. Each lab has its own culture. Some things to consider include whether you're interested in computational/theoretical or experimental research. Would you be working under the supervision of the professor, postdoctoral researcher, or a graduate student? What time commitment is needed to make progress on the project? (Does that fit with your course load and schedule?) What projects are available? What kind of tasks would you do? What course knowledge or skills are needed? You can also check out what previous years' graduating seniors did for their theses by looking at linked flyers for senior thesis presentations on the [list of past colloquia](#).

If you are going to be doing research for credit (PHYS 095 or 195), you will need to submit an [Independent Study Form](#). Research courses do not show up on the schedule. Note that you don't need to sign up for research credits in order to do research with a faculty member; contact them anytime throughout the year.

Typically funding is available to pay you for summer research from the faculty's research grants. Occasionally there may be funding available for academic-year research as well, including through the Center for Cellular and Biomolecular Machines (CCBM)'s [undergraduate research fellowship program](#).

### 5.2.2 Conferences

There are a variety of conferences that you can attend, in order to present a poster or maybe even a talk about your research, learn about research, network with others, talk to graduate school representatives, find a peer support group, learn about careers, and engage in professional development. Funding to attend can be available from the physics department, the faculty research group you are working with, or the conference itself. These are some conferences specifically aimed at undergraduates which UC Merced students have attended recently:

1. The [Conferences for Undergraduate Women in Physics \(CUWiP\)](#) is held annually in January somewhere in northern California along with other sites around the country. UC Merced hosted in 2023.
2. The American Physical Society [Far West Section](#) meeting is held annually in the fall, somewhere in CA, NV, or HI (San Diego in 2023). UC Merced hosted in 2017.
3. The [Physics Congress \(PhysCon\)](#) is held every two years somewhere in the country around November; it is specifically for undergraduates and is related to the Society of Physics Students (SPS).
4. The [National Diversity in STEM](#) conference is held annually by the Society for the Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) somewhere in the country around the end of October. Also there is a [SACNAS chapter](#) on campus.

If you have some research results to show, you could also attend one of the annual national research conferences that our faculty and graduate students often attend such as the [American Physical Society March Meeting](#) or [American Astronomical Society](#) (January).

### 5.2.3 UROC

The Undergraduate Research Opportunities Center ([UROC](#)) is a great resource on campus and also runs the Summer Undergraduate Research Institute (SURI). UROC offers information sessions to help you submit applications for summer internships. It also posts UC Merced and UC-specific internships. For example, the [UC LEADS](#) program lasts 2 years, with one summer doing research at UC Merced, and the other summer doing research on another UC campus. There is also the [California Alliance for Minority Participation \(CAMP\)](#). Physics majors have participated in both of these. Most programs advertised or organized by UROC have early spring deadlines.

### 5.2.4 Summer Internships

Summer internships are mostly *paid* internships and often include professional development activities. Check out the [CCBM](#) research opportunities related to biophysics and soft-matter physics.

Internships at other institutions are a great way to explore research areas we don't currently have at UC Merced (e.g. particle physics or nuclear physics), potential graduate programs, and/or potential career paths. The National Science Foundation (NSF) funds Research Experiences for Undergraduates (REU) at various universities, including one on [Physics Research at UC Merced](#). If you're considering graduate school and are curious about a particular school, see if they have an REU program. Use the [Physics Today Jobs](#) site to search for internships. SACNAS, the Society for the Advancement of Chicanos/Hispanics and Native Americans in Science, also lists internships. [Pathways to Science](#) is another useful search engine for summer programs. The Department of Energy (DOE) offers internships at 17 national labs (including nearby Lawrence Berkeley, Lawrence Livermore, and Sandia National Laboratories – there is a branch of Sandia in Livermore as well as New Mexico) and facilities through their [SULI](#) program. NASA internships are highly competitive and have early deadline. Caltech's Jet Propulsion Laboratory (JPL) has numerous opportunities. Federal Agencies, such as the National Institute of Science and Technology (NIST), will often list internships [here](#). For especially competitive programs, it is wise to submit your complete application well before the deadline.

We also have some special summer opportunities through partnerships between UC Merced and other institutions. There is a summer research program for high-powered lasers and plasma physics at a network of sites called [LaserNetUS](#), a training program for high-energy physics with Lawrence Livermore National Laboratory called the Livermore Physics Traineeship (LiPhT), and the [Consortium for High Energy Density Science \(CHEDS\)](#) which arranges summer research with Lawrence Livermore about high-power lasers and plasma physics as well as development of resources for physics labs with smartphones. Prof. Strubbe is the contact person for all 3 of these. There is also another training program for high-energy physics coordinated by Prof. Nierenberg, and the [underGraduate Research Educational Academic Traineeships in Nuclear Science \(GREAT-NS\)](#) through Lawrence Berkeley National Laboratory, coordinated by Prof. Mitchell.

## 6 Contact Information

- Physics Undergraduate Contacts
  - Dr. Menke, [cmenke@ucmerced.edu](mailto:cmenke@ucmerced.edu)
  - Dr. Utter, [brianutter@ucmerced.edu](mailto:brianutter@ucmerced.edu)
- Physics Academic Advisor, Jenn Souza, [souza5@ucmerced.edu](mailto:souza5@ucmerced.edu)

## Sample Plan for Physics: Astrophysics Emphasis

### First Year

#### Fall

MATH 021 Calculus I for Physical Sciences & Engineering  
SPARK Seminar  
PHYS 08 & 08L Introductory Physics I & Lab  
CHEM 02/02H General Chemistry I

#### Spring

MATH 022 Calculus II for Physical Sciences & Engineering  
Computer Science Requirement  
WRI 10 College Reading & Composition  
PHYS 09 & 09L Introductory Physics II & Lab

### Second Year

#### Fall

General Education  
PHYS 10 Introductory Physics III  
PHYS 108 Thermal Physics Core  
MATH 023 Vector Calculus

#### Spring

MATH 024 Linear Algebra & Differential Equations  
PHYS 105 Analytics Mechanics Core  
General Education  
PHYS 126 Special Relativity Minicourse

### Third Year

#### Fall

MATH 32 Probability and Statistics  
PHYS 110 Electrodynamics Core  
PHYS 137 Quantum Mechanics Core  
General Education

#### Spring

PHYS 115 Electrodynamics Core Waves II  
PHYS 138 Quantum Mechanics II Core  
PHYS 160 Modern Physics Lab  
General Education

### Fourth Year

#### Fall

PHYS 123 Stellar Structure and Interstellar Medium (Even Years)  
PHYS 195  
Astrophysics Emphasis Elective  
General Education

#### Spring

PHYS 121 Cosmology (Even Years)  
PHYS 196  
Free Elective  
Free Elective

## Sample Plan for Physics: Biophysics and Soft Matter Emphasis

### First Year

#### Fall

MATH 021 Calculus I for Physical Sciences & Engineering  
SPARK Seminar  
PHYS 08 & 08L Introductory Physics I & Lab  
CHEM 02/02H General Chemistry I

#### Spring

MATH 022 Calculus II for Physical Sciences & Engineering  
Computer Science Requirement  
WRI 10 College Reading & Composition  
PHYS 09 & 09L Introductory Physics II & Lab

### Second Year

#### Fall

General Education  
PHYS 10 Introductory Physics III  
PHYS 108 Thermal Physics Core  
MATH 023 Vector Calculus

#### Spring

MATH 024 Linear Algebra & Differential Equations  
PHYS 105 Analytics Mechanics Core  
General Education  
PHYS 126 Special Relativity Minicourse

### Third Year

#### Fall

PHYS 104 Biophysics (Even Years)  
PHYS 110 Electrodynamics Core  
PHYS 137 Quantum Mechanics Core  
BIO 01/01L Contemporary Biology w/ Lab

#### Spring

PHYS 109 Soft Matter Physics (Odd Years)  
PHYS 138 Quantum Mechanics II Core  
PHYS 160 Modern Physics Lab  
BIO 02/02L Intro to Molecular Biology w/ Lab

### Fourth Year

#### Fall

Biophysics Emphasis Elective  
PHYS 195  
MATH 32 Probability and Statistics  
General Education

#### Spring

PHYS 115 Electrodynamics Core Waves II  
PHYS 196  
Free Elective  
General Education

## Sample Plan for Physics: Computation and Data Science Emphasis

### First Year

#### Fall

MATH 021 Calculus I for Physical Sciences & Engineering  
SPARK Seminar  
PHYS 08 & 08L Introductory Physics I & Lab  
CHEM 02/02H General Chemistry I

#### Spring

MATH 022 Calculus II for Physical Sciences & Engineering  
Computer Science Requirement  
WRI 10 College Reading & Composition  
PHYS 09 & 09L Introductory Physics II & Lab

### Second Year

#### Fall

MATH 32 Probability and Statistics  
PHYS 10 Introductory Physics III  
PHYS 108 Thermal Physics Core  
MATH 023 Vector Calculus

#### Spring

MATH 024 Linear Algebra & Differential Equations  
PHYS 105 Analytics Mechanics Core  
General Education  
PHYS 126 Special Relativity Minicourse

### Third Year

#### Fall

PHYS 127 Machine Learning and Statistics for Physics and Astronomy (Odd Years)  
PHYS 110 Electrodynamics Core  
PHYS 137 Quantum Mechanics Core  
General Education

#### Spring

PHYS 115 Electrodynamics Core Waves II  
PHYS 138 Quantum Mechanics II Core  
PHYS 160 Modern Physics Lab  
General Education

### Fourth Year

#### Fall

PHYS 181 Computational Physics (Even Years)  
PHYS 195  
Free Elective  
Free Elective

#### Spring

Computation and Data Science Emphasis Elective  
PHYS 196  
Free Elective  
General Education

## Sample Plan for Physics: Custom Emphasis

### First Year

#### Fall

MATH 021 Calculus I for Physical Sciences & Engineering  
SPARK Seminar  
PHYS 08 & 08L Introductory Physics I & Lab  
CHEM 02/02H General Chemistry I

#### Spring

MATH 022 Calculus II for Physical Sciences & Engineering  
Computer Science Requirement  
WRI 10 College Reading & Composition  
PHYS 09 & 09L Introductory Physics II & Lab

### Second Year

#### Fall

General Education  
PHYS 10 Introductory Physics III  
PHYS 108 Thermal Physics Core  
MATH 023 Vector Calculus

#### Spring

MATH 024 Linear Algebra & Differential Equations  
PHYS 105 Analytics Mechanics Core  
Free Elective  
PHYS 126 Special Relativity Minicourse

### Third Year

#### Fall

MATH 32 Probability and Statistics  
PHYS 110 Electrodynamics Core  
PHYS 137 Quantum Mechanics Core  
General Education

#### Spring

PHYS 115 Electrodynamics Core Waves II  
PHYS 138 Quantum Mechanics II Core  
PHYS 160 Modern Physics Lab  
Free Elective

### Fourth Year

#### Fall

Custom Emphasis Elective  
PHYS 195  
Free Elective  
General Education

#### Spring

Custom Emphasis Elective  
PHYS 196  
Custom Emphasis Elective  
General Education

## Sample Plan for Physics: Engineering and Applied Physics Emphasis

### First Year

#### Fall

MATH 021 Calculus I for Physical Sciences & Engineering  
SPARK Seminar  
PHYS 08 & 08L Introductory Physics I & Lab  
CHEM 02/02H General Chemistry I

#### Spring

MATH 022 Calculus II for Physical Sciences & Engineering  
Computer Science Requirement  
WRI 10 College Reading & Composition  
PHYS 09 & 09L Introductory Physics II & Lab

### Second Year

#### Fall

General Education  
PHYS 10 Introductory Physics III  
PHYS 108 Thermal Physics Core  
MATH 023 Vector Calculus

#### Spring

MATH 024 Linear Algebra & Differential Equations  
PHYS 105 Analytics Mechanics Core  
Free Elective  
PHYS 126 Special Relativity Minicourse

### Third Year

#### Fall

MATH 32 Probability and Statistics  
PHYS 110 Electrodynamics Core  
PHYS 137 Quantum Mechanics Core  
General Education

#### Spring

PHYS 115 Electrodynamics Core Waves II  
PHYS 138 Quantum Mechanics II Core  
PHYS 160 Modern Physics Lab  
General Education

### Fourth Year

#### Fall

Engineering and Applied Physics Emphasis Elective  
ENGR 193 Engineering Capstone  
Engineering and Applied Physics Emphasis Elective  
General Education

#### Spring

Engineering and Applied Physics Emphasis Elective  
ENGR 194 Engineering Capstone  
Engineering and Applied Physics Emphasis Elective  
Free Elective



## Sample Plan for Physics: Mathematical and Computational Physics Emphasis

### First Year

#### Fall

MATH 021 Calculus I for Physical Sciences & Engineering  
SPARK Seminar  
PHYS 08 & 08L Introductory Physics I & Lab  
CHEM 02/02H General Chemistry I

#### Spring

MATH 022 Calculus II for Physical Sciences & Engineering  
Computer Science Requirement  
WRI 10 College Reading & Composition  
PHYS 09 & 09L Introductory Physics II & Lab

### Second Year

#### Fall

General Education  
PHYS 10 Introductory Physics III  
PHYS 108 Thermal Physics Core  
MATH 023 Vector Calculus

#### Spring

MATH 024 Linear Algebra & Differential Equations  
PHYS 105 Analytics Mechanics Core  
Free Elective  
PHYS 126 Special Relativity Minicourse

### Third Year

#### Fall

PHYS 116 Mathematical Methods (Odd Years)  
PHYS 110 Electrodynamics Core  
PHYS 137 Quantum Mechanics Core  
General Education

#### Spring

PHYS 115 Electrodynamics Core Waves II  
PHYS 138 Quantum Mechanics II Core  
PHYS 160 Modern Physics Lab  
General Education

### Fourth Year

#### Fall

PHYS 181 Computational Physics (Even Years)  
PHYS 195  
Free Elective  
MATH 32 Probability and Statistics

#### Spring

Mathematical and Computational Physics Emphasis Elective  
PHYS 196  
Free Elective  
General Education

## Sample Plan for Physics: No Emphasis

### First Year

#### Fall

MATH 021 Calculus I for Physical Sciences & Engineering  
SPARK Seminar  
PHYS 08 & 08L Introductory Physics I & Lab  
CHEM 02/02H General Chemistry I

#### Spring

MATH 022 Calculus II for Physical Sciences & Engineering  
Computer Science Requirement  
WRI 10 College Reading & Composition  
PHYS 09 & 09L Introductory Physics II & Lab

### Second Year

#### Fall

General Education  
PHYS 10 Introductory Physics III  
PHYS 108 Thermal Physics Core  
MATH 023 Vector Calculus

#### Spring

MATH 024 Linear Algebra & Differential Equations  
PHYS 105 Analytics Mechanics Core  
Free Elective  
PHYS 126 Special Relativity Minicourse

### Third Year

#### Fall

MATH 32 Probability and Statistics  
PHYS 110 Electrodynamics Core  
PHYS 137 Quantum Mechanics Core  
General Education

#### Spring

PHYS 115 Electrodynamics Core Waves II  
PHYS 138 Quantum Mechanics II Core  
PHYS 160 Modern Physics Lab  
General Education

### Fourth Year

#### Fall

PHYS Elective  
PHYS 195  
Free Elective  
General Education

#### Spring

PHYS Elective  
PHYS 196  
Free Elective  
Free Elective

## Sample Plan for Physics: Quantum Science and Technology Emphasis

### First Year

#### Fall

MATH 021 Calculus I for Physical Sciences & Engineering  
SPARK Seminar  
PHYS 08 & 08L Introductory Physics I & Lab  
CHEM 02/02H General Chemistry I

#### Spring

MATH 022 Calculus II for Physical Sciences & Engineering  
Computer Science Requirement  
WRI 10 College Reading & Composition  
PHYS 09 & 09L Introductory Physics II & Lab

### Second Year

#### Fall

General Education  
PHYS 10 Introductory Physics III  
PHYS 108 Thermal Physics Core  
MATH 023 Vector Calculus

#### Spring

MATH 024 Linear Algebra & Differential Equations  
PHYS 105 Analytics Mechanics Core  
Free Elective  
PHYS 126 Special Relativity Minicourse

### Third Year

#### Fall

MATH 32 Probability and Statistics  
PHYS 110 Electrodynamics Core  
PHYS 137 Quantum Mechanics Core  
General Education

#### Spring

PHYS 115 Electrodynamics Core Waves II  
PHYS 138 Quantum Mechanics II Core  
PHYS 160 Modern Physics Lab  
Quantum Science and Technology Emphasis Elective

### Fourth Year

#### Fall

Quantum Science and Technology Emphasis Elective  
PHYS 195  
General Education  
General Education

#### Spring

Quantum Science and Technology Emphasis Elective  
PHYS 196  
Free Elective  
Free Elective