Physics and Engineering Student Handbook

Truman State University

Fall 2013 – Spring 2014

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Truman State University
Kirksville, Missouri

This, the 14th edition of the Truman State University Physics and Engineering Student Handbook, was revised by Dr. Ian M. Lindevald, Dr. Taner Edis, and Adam Gouge. Much of the credit for its contents belongs to the original student writers, Kathy R. Jenkins and J. Andrew Upchurch, working in association with Dr. Maria Di Stefano and the Physics Department Faculty. Some portions of this handbook were taken from other Truman State University material.

This handbook represents the best of our knowledge at the time of the last revision, September 2013. While the physics faculty have carefully looked over this information, we cannot absolutely guarantee its accuracy. Please remember that the Truman General/Graduate Catalog is your official source of information for all degree requirements etc.

Contents

Introduction

This is a reference guide for physics and pre-engineering studies at Truman State University. It is intended to help first years learn the ins and outs of the department. Upperclass students might use this handbook when planning for future semesters.

Chapter 1 is devoted to presenting information applicable to both physics and pre-engineering majors, on such things as advisors, physics tutorial services, the Society of Physics Students and assessment at Truman. Also in this section is advice from alumni of the physics program—helpful hints and suggestions on how to make the most of your time here.

Chapter 2 is specifically for physics majors and minors. It describes the physics department, general honors, and double-majoring. It also gives information on how to ensure you will be prepared for graduation and ready for the next step: graduate school or a job.

Chapter 3 is dedicated to pre-engineering and the Dual Degree program. It focuses on the process of transferring to an engineering school when your Truman coursework is complete.

In Chapter 4 lists the physics faculty: names, locations, email addresses, and phone numbers. It's a very good idea to seek out and get to know the faculty! They are always available during their posted office hours, and are usually available at other times as well.

Finally, there are a number of helpful physics curriculum summary documents in Chapter 5.

We suggest that you refer to this handbook often during your stay at Truman, but we also remind you that the best source for complete, correct and updated information is your academic advisor.

The Physics Faculty

Chapter 1

General Information

1.1 Sources of Help

Academic Advisors

Each student is initially assigned an academic advisor in their residential college. Advisor assignments are announced at the beginning of the freshman year. You should meet with your advisor frequently to talk about your progress and to develop your courses of study.

After your freshman year, you will be assigned an official faculty advisor. Although it is a good idea to keep one physics advisor throughout your academic career, after your freshman year, you may change your advisor at any time.

Registration for classes is done online each semester by individual students. However, you need your academic advisor's approval to register for classes and to make changes in your class schedule. Set up an appointment well before your registration time, and come to the meeting well prepared. Consult your advisor often, ask questions even if they seem of little importance, and be sure to also tell your advisor when everything is going fine!

Tutorial Services

- *The Society of Physics Students* (SPS) offers free tutoring for introductory physics courses, usually in MG 2003 from Sunday through Thursday, 6 to 8 pm. For information regarding times and places contact Dr. Taner Edis at *edis@truman.edu*.

- *AXE* provides free tutoring for introductory chemistry courses. Their time and place are typically the same as for SPS.
- Math tutoring is often set up for each class by the instructor.
- Another resource for tutoring is The Center for Academic Excellence (`excellence.truman.edu`).

1.2 Student Organizations

The Society of Physics Students

The *The Society of Physics Students* (SPS; `sps.truman.edu`) is a social organization for everyone with an interest in physics—physics majors, pre-engineers, math majors, and others. SPS is the driving force behind the activities that bring the students and faculty together. These activities include picnics, dinners, trips, and meetings. SPS helps to create a sense of community within the department and promotes friendship among the students and faculty.

Currently, SPS meets over pizza once every two weeks, in a room in Magruder Hall that changes from semester to semester. For dues of $5 a semester, all that pizza is a good deal. Email Taner Edis (*edis@truman.edu*) to get the latest information.

Aside from social activities, SPS coordinates a tutoring program. Every evening, Sunday through Thursday, one or two junior or senior level physics majors are available for a few hours to help students who are enrolled in physics classes. Then there is the SPS Demo Team which takes fun physics demonstrations to local elementary and high schools to stimulate excitement about science in young people. On occasion, SPS will take a trip to a national laboratory or a university to observe cutting-edge research, and periodically they host a Zone Meeting for several SPS chapters from other universities in our region of the country.

Ask how you can obtain the most recent SPS-designed Truman physics T-shirt.

Sigma Pi Sigma

Sigma Pi Sigma is the physics honor society. Students who have completed both semesters of calculus-based general physics (Phys

195 and 196), who have donated at least one semester of physics-related service (such as physics tutoring or physics outreach), and who remain in the top third of their class by overall GPA are invited into membership and inducted into the society in the Spring semester. Membership in ΣΠΣ is lifelong and is a great honor.

Stargazers Astronomy Club

The *Stargazers Astronomy Club* (`stargazers.truman.edu`) is open to all students interested in astronomy. Members perform observations with telescopes, and participate in long-term observing projects, field trips, and other activities. No prior experience is required.

The Truman State University Observatory is located at the the University Farm, about one mile west of campus. The Observatory is home to all astronomy-related activities in the Physics department, including astronomy research projects, astronomy class labs, public open house events, and casual stargazing. Facilities include a computer controlled 14-inch Schmidt-Cassegrain telescope housed in a five-meter rotating dome; several other refracting and reflecting telescopes; two CCD cameras for imaging; and several radio telescopes. Students with appropriate training may use the Observatory facilities for research or for casual observing.

Women In Physics

Advised by Dr. Maria Di Stefano, *Women in Physics* supports female physics and engineering majors and minors, but is open to all students. Their activities include meetings every other week and social functions such as designing WIP T-shirts, sports events with other clubs, bonfires, and movie nights. WIP actively promotes the idea that physics is not just for guys, and they communicate this to new students at majors day and potential students at visit days. Community service includes the Big Event and physics demonstrations for kids in elementary school at the Adair County Public Library at least once each semester. Members have the opportunity to travel to national conferences for women in physics, which have been in Nebraska and Illinois in the past. These conferences are great ways to learn about research, graduate school, and physics careers, as well as network with physics majors outside of Truman.

1.3 Advice from Alumni and Upperclass Students

After spending several years in our physics programs, graduating students and experienced undergraduates offer the following advice to beginning students:

Review Math Skills

You should try to take Phys 195 no later than the spring of your freshman year. Math skills are essential to physics, so you should also begin the calculus sequence as early as possible. Students must take Calculus I (Math 198) either before or simultaneously with Physics with Calculus I (Phys 195), the first course in a two semester sequence, providing the foundation of all physics and engineering studies. If your math skills are weak, before calculus you should take a course such as Precalculus (Math 186). Note that students who do this may delay their graduation by a semester or two.

Study Skills

Take responsibility for your own learning. One recent graduate said that his greatest regret is that he did not learn to really read a physics textbook until late in his junior year. Had he read better in his early years, he would have felt much more confident in his preparation for graduate school. Learn to read carefully and deeply. Do extra problems because they are interesting and sometimes even fun. Ask for help and advice in developing your study skills. Work together with your fellow students.

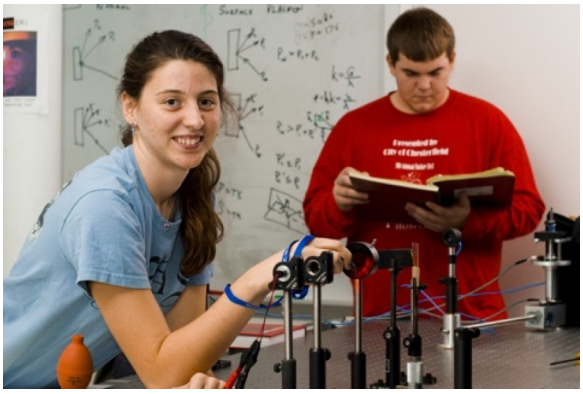
Portfolio

Some alumni have found it helpful to create and maintain a portfolio consisting of all essays and letters of application to scholarships, research positions, leadership recognition awards and universities. If available, include recommendation letters written for the student by faculty, advisors, and employers. This portfolio can then be used later in developing personal statements for graduate school, summer research opportunities, and employment.

Double Majors

Many students who major in physics also major in another field. In the past, double majors included mathematics, chemistry, computer science, foreign language, music, psychology, classics, political science and philosophy. The mathematics double major is easy to set up because physics already has many math requirements. Dual majors will enhance applications for graduate school or employment. Furthermore, graduating with General Honors is easier if you complete a double-major. On the other hand, it is difficult to graduate in four years with a non-math double major.

Research Opportunities



There are numerous research opportunities available.

Graduate schools place a high value on research experience when evaluating their applicants. For this reason, in addition to the required research credit, physics majors are encouraged to perform as much research on- and off-campus as possible. It is best to begin your research during your sophomore year and continue your project during your junior and senior years. Some students have done research as early as the spring semester of their freshman year. Pre-engineers are also welcome to participate in research.

Off-campus summer research opportunities, such as "Research Experiences for Undergraduates" (REU) programs, can be very exciting. Such opportunities are posted on the bulletin boards around the third floor physics area of Magruder Hall. Links to Web sites list-

ing REUs are available on `physics.truman.edu/information.asp`.

Please note that while research is important, your first priority should be your classes. Do not let your research take away from time spent learning in classes.

Presentation Opportunities

Professionals in any field are frequently called upon to give presentations relating to their research. Since practice makes perfect, you should try to give as many presentations as possible. Opportunities for students to present their work include the Student Research Conference, which takes place at Truman every spring, the spring and fall zone meetings of SPS, the spring meeting of the Missouri Academy of Science, and the annual meeting of the National Council for Undergraduate Research (NCUR).

Summary of Advice from Students

- Get involved in research. Talk to professors. See where their interests lie.
- Look for internships early. See if you could shadow someone in physics or engineering.
- Attend physics colloquia regularly.
- Talk to upperclass students.
- Join SPS and Sigma Pi Sigma.
- Join the SPS Demo Team.
- Volunteer for SPS tutoring. It is a great way to reinforce the ideas covered in class.
- Grades aren't everything. Focus more on learning. But make sure you get good grades.
- Things will become clearer your second year. Don't freak out.
- Don't leave LSP courses to your last two years.
- LaTeX is good. Learn it.

- Focus on your specific interests in physics. Do you know what your interests are? Look into them.
- Map out your four year plan early.
- Start working on homework *early*.
- Review past tests. Don't be afraid to study too hard.

1.4 Advice from Physics Faculty

Math Class Sequence

If you have been placed in a math class below Precalculus (Math 186), such as Algebra or Trigonometry, you should realize that you may find yourself one half to a full year behind the usual sequence. The physics and pre-engineering sequence of classes follows a very definite order during the first two years. This sequence begins with Physics with Calculus I (Phys 195), which requires being enrolled in the calculus sequence (Math 198, 263, 264 and 365) as early as possible.

LSP Core Classes

It is a good idea to take the Liberal Studies Program (LSP) classes as early as possible. Some of them, such as Writing as Critical Thinking (Eng 190) and Fundamentals of Speech (Comm 170), are designed to enhance skills that will support performance in other courses. In any given semester, it is best if you take the LSP courses for your own class level. Courses at a student's college level will usually be intellectually challenging and enjoyable. Don't wait until your senior year to take a required 100 level class!

Course Number Order

Course numbers are an indicator of difficulty but do not necessarily indicate the order in which classes need to be taken. 100 through 199 level courses are usually surveys. 200 through 299 level courses are often introductory. 300 through 499 level courses are upper-level classes. These classes cover specific topics and are usually the domain of Juniors and Seniors. 500 level and above are graduate classes, appropriate only for senior level students.

Ordinary Differential Equations

Try to take Ordinary Differential Equations (Math 365) before taking Classical Mechanics (Phys 386). Even though it is a co-requisite, a good understanding of ODE's aids in understanding many ideas in Classical Mechanics.

Linear Algebra and Quantum Mechanics

Take Linear Algebra (Math 357) before taking Quantum Mechanics (Phys 580). Although it is not a prerequisite, a working knowledge of linear algebra makes quantum mechanics easier.

1.5 Assessment

Truman has an important assessment program consisting of several tests, surveys, and a portfolio of writings gathered throughout a student's time at Truman. These instruments are a way for the university to evaluate itself, and have no effect on academic standing or on GPA. However, try to do the best you can, as the university uses these assessment tools to improve its programs. This affects not only you, but also those who follow in years to come.

Class Evaluations

Near the end of each semester, students are asked to fill out a questionnaire regarding each class they took. The questionnaire surveys students about issues like the content of the course, its organization, the effectiveness of the teaching techniques and the level of the student's participation. The evaluations are completely confidential, and the evaluation results are given to the instructor only after they have submitted the final grades. These evaluations are used by instructors to improve their teaching.

Writing Assessment

Truman State University is dedicated to the notion that liberally educated people are good writers and that writing enhances one's understanding of complex ideas. The Liberal Studies Program (LSP)

requires all students to take Eng 190, Writing as Critical Thinking, and at least three additional courses designated as "writing enhanced." One of those is the required Junior Interdisciplinary Seminar (Jins) course. All physics majors satisfy a second writing enhanced requirement through Phys 388, Advanced Lab.

Use the resources of The Writing Center on the top floor of McClain Hall in developing good skills as a writer. Keep a file of your writings so you can review your growth as a writer, and so you will have a sample of your work to submit in your senior portfolio.

The LSP Portfolio

The LSP Portfolio gives you an opportunity as a senior to look back to where you started and to reflect on your growth during your academic career. It is read by a team of faculty and used to assess the university's programs. From the beginning of the freshman year, each student is expected to save all material that reflects on his or her experiences at Truman. Examples include papers, lab reports, examinations, projects, and other works. In their senior year, students choose and submit samples of work that are most representative of certain aspects of their education. Finally, you compose a letter reflecting on your intellectual growth while at Truman.

Major Field Achievement Test (MFAT)

The Major Field Achievement Test (MFAT) is a national standardized test that is taken during the senior year. Its purpose is to measure a student's skills and knowledge in their major, and the results are used by the discipline to improve the major. All physics majors take the physics MFAT, even double majors. To graduate, you must score at or above the 20^{th} percentile. The test itself is a standardized multiple choice test that covers all areas in physics.

1.6 Other Physics Testing

Physics Midcourse Test

The physics discipline tests its majors on their knowledge of General Physics during Modern Physics II (Phys 351). The test does not affect any grade, but you are required to discuss the results with

your physics advisor. The purpose is to identify weaknesses in the your general physics background, so they can be addressed before they prevent progress in the advanced physics courses.

Graduate Record Examination (GRE)

The Graduate Record Exam (GRE) is taken by those seniors who wish to attend graduate school and is not a requirement for all Truman students. There are two types of GRE exams: General Subject and Major Subject. The General Subject GRE measures verbal, quantitative, and analytical abilities, and can be taken online at any time for a fee of $185. The office of Assessment and Testing (VH 1130) has further information.

Like the MFAT, the Physics Subject GRE is a standardized multiple choice test that is nationally normed. The GRE may be taken numerous times in order to improve your score. It is offered three times each year, in September, October, and April, at a current cost of $150 per exam. The use of the GRE as an entrance requirement varies amongst graduate schools. You should check with the graduate schools you intend to apply to before taking the exam.

1.7 Useful Websites

Truman Physics	`http://physics.truman.edu/`
Society of Physics Students	`http://sps.truman.edu`
Sigma Pi Sigma	`http://www.sigmapisigma.org`
General / Graduate Catalog	`http://catalog.truman.edu/`

1.8 Physics Students Mailing List

Physics students can keep up to date on what going on in the department by joining the mailing list *phys-students@truman.edu* (email Taner Edis, *edis@truman.edu*, to get on it). You will get notified of SPS meetings, scholarship and research opportunities, upcoming colloquia, and other useful stuff. All physics majors are assumed to be on this list to get this news, so make sure you're getting this mail.

Chapter 2

Physics Program

2.1 The BS and the BA

For physics majors (not the pre-engineers) Truman offers two programs: the BS (Bachelor of Science) and BA (Bachelor of Arts). You will decide which option is best for you, but there is no rush. For your first two years there is no significant difference between the BS and the BA.

The BS degree in Physics is designed for students planning to continue their physics studies in graduate school. This program is less flexible; you take pretty much every physics course offered, and get trained for entering and succeeding in a good graduate school. This usually leads to a physics-related career.

The BA in Physics is for students who want a rigorous undergraduate experience in physics, but who are not necessarily planning a career in physics. The strong focus on critical thinking, problem solving, and the ability to work and learn independently make a degree in physics from Truman excellent preparation for a variety of non-physics career paths such as law or medical school, secondary school teaching or work in industry.

After three semesters of basic Physics and Calculus, BA students take Modern Physics, and then choose at least 6 hours from among more advanced topics such as Electronics, Classical Mechanics and Electromagnetism, Statistical Mechanics, and Quantum Mechanics. In addition, students do Advanced Laboratory work. BA candidates must also design their own 15 hour Learning Plan outside of physics—this could, for example, be a minor in another discipline.

The BA also requires intermediate proficiency in a foreign language, while elementary proficiency is sufficient for a BS.

Recent graduates from Truman's physics program have gone on to work in many different fields, such as in energy and environmental policy, in medicine, in the environmental clean-up industry and in the entertainment software industry.

2.2 General Requirements

Physics 388 (Advanced Lab).

Credit Hours

A BS in physics consists of 63 hours of physics-related course work and an additional 32 to 60 hours to satisfy the Liberal Studies Program (LSP) and other graduation requirements. Students need an average of 15 credit hours per semester to graduate with the minimum of 120 total credit hours.

A BA in physics includes 45 hours of physics-related course work, a 15-hour Learning Plan or a minor (or second major) that must be pre-approved by a committee of three physics faculty members, and an additional 32 to 60 hours to satisfy the Liberal Studies Program (LSP) and other graduation requirements.

Capstone Experiences and Research

A BS physics major is required to take at least three hours total for research experiences from PHYS 441, 442, or 443, or, alternatively, to have an approved external research experience (such as an REU). They then present their research as part of the capstone seminar, PHYS 492.

The capstone for the BA degree is the one credit hour PHYS 445, Advanced Physics Seminar, in which students engage in a literature study on a focussed area in physics culminating in a paper and a public presentation on the topic. BA majors may opt to fulfill the BS research capstone in lieu of PHYS 445.

Applying for Graduation

An undergraduate student should file an application for the degree after completing 75 credit hours. A complete graduation application consists of:

1. A Bachelor Degree Application Form with the advisor's signature. (Forms are available in the Science Office and in the Registrar's Office.)
2. The appropriate major worksheet(s). (Available on-line and similar to the ones are found in the back of this handbook.)
3. The appropriate minor worksheet(s), if applicable. (In lieu of a minor worksheet, students may photocopy the page from the catalog listing the minor requirements.)

The following are minimum requirements that must be met by all undergraduate candidates:

- 2.0 minimum Truman G.P.A.
- 2.0 minimum major G.P.A.
- 2.0 minimum cumulative G.P.A.
- 40 semester hours in 300-, 400-, and 500-level courses
- 63 hours of liberal arts and sciences coursework
- Minimum 124 semester hours total

- Assessment Requirements (Junior Test, portfolio, and MFAT)
- Successful completion of all LSP requirements including 3 courses designated as Writing Enhanced (JINS, Advanced Physics Lab [PHYS 388], and one other)
- Completion of all major requirements
- Completion of the clearance form (which will be distributed to graduating students about 4 weeks before graduation)

General/Graduate Catalog

Students with questions about graduation requirements should consult the General/Graduate Catalog and speak with their advisors.

Additional Information

In addition to the items stated previously, candidates should take note of the following:

- Off-campus and correspondence courses taken during the final semester must be cleared with the Vice President for Academic Affairs, the advisor, the physics chair, and the Registrar.
- For all repeated courses, a repeat form must be filed with the Registrar's Office.
- All courses substituted must be approved through the advisor, the physics chair, and the Vice President for Academic Affairs.
- If the student is graduating in absentia, he or she must notify the Vice President for Academic Affairs.

2.3 Honors Curriculum

Departmental Honors

Honors in Physics are awarded to all graduating physics majors who meet at least one of the following two requirements: a) a grade point average in the physics courses required for the major which equals or exceeds 3.5, and a score at or above the 90th percentile in the Physics Major Field Achievement Test, or b) a grade point

average in the major requirements which equals or exceeds 3.75 and a score at or above the 80th percentile in the Physics Major Field Achievement Test.

Honors Scholars Program

Honors Scholar in the Arts and Sciences is awarded to graduating seniors who have completed five approved courses, with at least one course from each of the areas of mathematics, science, humanities, and social science, and with a cumulative grade point average of at least 3.5. Only grades of "A" and "B" may count toward the Honors Scholar grade point average requirements of at least 3.5 in those five courses and students must have an overall grade point average of 3.5. Also, only courses with three or more hours of credit may count toward becoming an Honors Scholar. Students who complete a single undergraduate major may not satisfy Honors Scholar requirements with any course in their major field.

2.4 Other Physics-related Programs

Minor in Physics

An academic minor provides contrasting and parallel study to the major. Serving to complement the major and help students further expand and integrate knowledge, academic minors are offered in a variety of disciplinary and interdisciplinary subjects. Students who choose to pursue minors should seek advice from faculty members in their minor disciplines, as well as from their advisors in their major program. Students minoring in physics are welcomed as full members in the community of physics faculty and students.

The Physics Minor requires the successful completion of the following courses:

PHYS 195	Physics with Calculus I	(5 credits)
PHYS 196	Physics with Calculus II	(5 credits)
PHYS 250	Modern Physics I	(3 credits)
PHYS 275	Vibrations and Waves	(3 credits)
OR		
PHYS 382	Mathematical Physics	(3 credits)

and an additional 3 hours from any PHYS courses at the 300, 400, or 500 level (for example, PHYS 482); or from either NASC 400 or NASC 401; or PHYS 251 (Modern Physics II).

Please note that taking these courses will require additional prerequisites such as calculus.

Double Majors

Students should be aware that since physics requires intense mathematical studies, physics majors need only a few extra classes to also obtain a degree in mathematics.

Master of Arts in Education (MAE)

The Master of Arts in Education (MAE) Program prepares students to teach at the elementary or secondary level after completing an undergraduate major and the MAE Program. To facilitate a timely admittance to the MAE program, physics majors must plan their coursework following preestablished guidelines. Undergraduate students will maintain contact with the Department of Education through organizations, coursework, newsletters, and their own initiative. During each undergraduate year, students become more involved with the education program until they are ready to apply for admission to the Master of Arts in Education program during their senior year.

In addition to the general undergraduate certification requirement, the Missouri State Department of Education establishes subject-matter requirements to meet standards for teaching in public schools in Missouri. These subject-matter requirements are not automatically fulfilled in all majors at Truman State University. Students who plan to apply for admission to the Master of Arts in Education Program will be required to fulfill subject-matter teaching requirements in their chosen field. For additional information, students should visit with the Certification Officer in the Department of Education. Visit `education.truman.edu` to find out more.

Certification requirements for teaching in Missouri can be found in the Education Department's section of the General Bulletin.

Chapter 3

Pre-Engineering and Dual Degree Programs

For the first two years, the courses taken by both physics and pre-engineering majors are nearly identical.

3.1 Pre-Engineering Program

Truman State University offers a pre-engineering program in which a student attends Truman for two years and then transfers to an engineering school of their choice. During their stay at Truman, pre-engineers take a mathematics sequence consisting of Calculus I, II, and III and Ordinary Differential Equations (MATH 198, 263, 264 and 365), a calculus-based introductory physics sequence: Physics with Calculus I and II (PHYS 195 and 196); and General Chemistry I (CHEM 130). Courses in English, Communications, the Humanities and Social Sciences make up the rest of their course load (for example, Writing as Critical Thinking (ENG 190), Fundamentals of Speech (COMM 170), Macro- or Microeconomics, U.S. History).

3.2 Accreditation

Most good engineering programs are accredited by the Accrediting Board of Engineering and Technology (ABET). For example, licensing requirements in the state of Missouri include an engineering degree awarded by an ABET accredited program (the accreditation

is given to individual programs within a school, not to the school). The guidelines for accreditation are strict, which make the curricula of different engineering schools very similar, and include specific regulations for the general education requirements.

3.3 Transfer Agreement

In designing the curriculum for pre-engineers, we take into account ABET guidelines, as well as the models presented by the Missouri University of Science and Technology (Rolla) and The University of Missouri—Columbia. Rolla and Mizzou are high quality engineering schools with which Truman has transfer agreements. When students come to Truman, they can simultaneously apply to Rolla. Enrolling in their Transfer Assistance Program ensures that students will have a smooth transition. Not all students transfer to Rolla or Columbia; many attend institutions outside of Missouri.

Why should a student enroll in our pre-engineering program instead of attending an engineering school for four years? Some students are not firmly decided that they would like to be engineers. For students inclined to explore their options, a liberal arts and sciences institution like Truman offers a tremendous array of opportunities, often not available in engineering schools. Truman is also more diverse; students are able to interact with people who have many different interests. Classes are small and a strong emphasis is placed on the interaction between faculty and students both in and out of the classroom. The class size for the engineering courses offered at Truman is typically less than a dozen students.

The physics faculty are well informed about the needs of pre-engineers and can assist them in their planning for engineering school. During the two years at Truman, pre-engineers enroll in many of the general education courses that are required of all majors, so if they decide to change majors, there will be no loss of time.

3.4 Dual Degree Program

The Truman Physics Discipline also offers a Dual Degree program. It takes an extra year to complete the undergraduate studies, but the

reward is that students graduate with two degrees: a B.A. in Physics from Truman and an engineering degree from another institution.

You spend your first three years at Truman, taking most of the courses required for a B.A. in Physics as well as all the courses and commitments required for any Truman undergraduate B.A. degree (i.e., LSP courses, foreign language proficiency and assessment requirements). You then transfer to another university to complete the remainder of your engineering degree. Truman courses transfer to the second institution, fulfilling its course requirements for the first two years, and some of the advanced engineering courses transfer back to Truman to finish up the B.A. Physics requirements. At the end, you have two degrees, making you better prepared than most for an advanced technical job or for graduate study.

The dual degree program is tight, and so it is best if you decide early that you want to pursue this challenging and rewarding course of study. If you are interested in the Dual Degree program, inquire about it with your physics advisor or any of the physics faculty.

Chapter 4

Physics Faculty

The year in parentheses indicates the year hired at Truman State University.

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Chapter 5

Curriculum Summaries and Major Worksheets

The following pages contain a number of helpful summaries of the different aspects of the physics programs. These represent the best and most up-to-date knowledge of the physics faculty, but please remember that they are not infallible. They are useful guides, but should not be considered official documents.

  - An outline of the Physics B.A. curriculum within the Dual Degree program.

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  - An outline of regularly taught physics courses (with Phys prefixes) tabulating prerequisites, co-requisites, and semesters offered for each.

You are allowed to use any set of graduation requirements that were approved from the time of your enrollment at Truman until the time you graduate. When applying for graduation, you will be asked which year's General Bulletin contains the program under which you want to graduate.

5.1 Degree Worksheets

Use a degree worksheet to plan your courses. You may locate a degree worksheet for your major at `catalog.truman.edu/`.

5.2 Degree Audit

From time to time, you should check on your course progress by processing your degree audit. Simply login to Truview, select the Student tab, and select "Process my degree audit" under the My Academic Records tab.

BS in Physics

Required Support	Calc I	198	5
	Calc II	263	5
	Calc III	264	3
	Chem I	130	4
	Stat 290	290	3
BS Reqs	ODE	365	3
	Linear Algebra	357	3
Major Reqs	Physics Seminar	145	1
	Physics with Calc I	195	5
	Physics with Calc II	196	5
	Modern I	250	3
	Modern II	251	3
	Vibrations & Waves	275	3
	Electronics	320	3
	Junior Seminar	345	1
	Math Physics	382	3
	Classical	386	3
	Adv Lab	388	3
	E&M	482	3
	Thermodynamics	486	3
	Research	441/2/3	3
	Capstone Seminar	492	1
	Advanced Topics	518	3
	Quantum Mechanics	580	3
	TOTAL =		**75***

Physics Minor

Physics with Calc I	195	5
Physics with Calc II	196	5
Modern 1	250	3
Vibrations & Waves	275	3
OR		
Mathematical Physics	382	3
Elective course (251, 300-500 level or NASC)		3
TOTAL =		**19***

BA in Physics

Required Support	Calc I	198	5
	Calc II	263	5
	Calc III	264	3
	ODE	130	3
	Chem I	130	4
	Stat 290	290	3
BA Reqs	Intermediate Proficiency in a Foreign Language		0 - 6
Major Reqs	Physics Seminar	145	1
	Physics with Calc I	195	5
	Physics with Calc II	196	5
	Modern I	250	3
	Modern II	251	3
	Vibrations & Waves	275	3
	Junior Seminar	345	1
	Math Physics	382	3
	Adv Lab	388	3
	Adv Phys/Capstone Sem	445/492	1
	PHYSICS ELECTIVES (6 hrs):		
	**Classical	386	3
	**E&M	482	3
	**Thermodynamics	486	3
	Electronics	320	3
	Advanced Topics	518	3
	Quantum Mechanics	580	3
	Research	441/2/3	1 - 3
	Learning Plan		15
	TOTAL =		**72 - 78***

*some of these credits may also fulfill LSP requirements

**At least one elective must be one of these

Typical Course Sequence-BA

	FALL	credits	SPRING	credits
Fresh	Calc 1	5	Calc 2	5
	Phys 1	5	Phys 2	5
	Seminar	1	Chem 1	4
	credit hours =	*11*	*credit hours =*	*14*
Soph	Calc 3	3	ODE	3
	Mod 1	3	Mod 2	3
	Vibs & Waves	3	Math Phys	3
	credit hours =	*9*	*credit hours =*	*9*
Junior	[See NOTE]		Junior Seminar	1
			Elective*	[3]
			Adv. Lab	3
	credit hours =	*0*	*credit hours =*	*4*
Senior	Elective*	3	Adv. or Cap. Sem.	1
	Elective*	3		
	credit hours =	*6*	*credit hours =*	*1*

*Two physics electives are required. Classical and electronics are fall courses. Most others are spring courses.

NOTE: Fall of junior year is free for study abroad, if desired. Alternatively, one or both of the electives listed in the senior year may be taken in the junior year.

"Late Start" Course Sequence-BA

	FALL	credits	SPRING	credits
Fresh	Chem 1	4	Calc 1	5
	**Seminar		Phys 1	5
	credit hours =	*4*	*credit hours =*	*10*
Soph	Calc 2	5	Calc 3	3
	Phys 2	5		
	**[Seminar]	1		
	credit hours =	*11*	*credit hours =*	*3*
Junior	Mod 1	3	Mod 2	3
	ODE	3	Math Phys	3
	Vibs & Waves	3	Junior Seminar	1
	Elective*	3	Elective*	3
	credit hours =	*12*	*credit hours =*	*10*
Senior	Elective*	[3]	Adv. or Cap. Sem.	1
			Adv. Lab	3
			Elective*	[3]
	credit hours =	*0*	*credit hours =*	*4*

** The early seminar (PHYS 145) should be taken in the freshman year unless the decision to be a physics major occurs too late. In that case the seminar should be taken in the sophomore year.

Typical Physics Major Course Sequence BS

	FALL	credits	SPRING	credits
Fresh	Calc 1	5	Calc 2	5
	Phys 1	5	Chem 1	4
	Seminar	1	Phys 2	5
	credit hours =	*11*	*credit hours =*	*14*
Soph	Calc 3	3	ODE	3
	Vibs & Waves	3	Math Phys	3
	Mod 1	3	Mod 2	3
	credit hours =	*9*	*credit hours =*	*9*
Junior	Classical	3	Thermodynamics	3
	Linear	3	E&M	3
	Electronics	3	Junior Seminar	1
	Stat 290	3	Adv. Lab	3
			Research	1
	credit hours =	*12*	*credit hours =*	*11*
Senior	Quantum	3	Adv. Topics	3
	Research	2	Capstone Sem.	1
	credit hours =	*5*	*credit hours =*	*4*

"Late Start" Course Sequence-BS

	FALL	credits	SPRING	credits
Fresh	*Seminar		Calc 1	5
			Phys 1	5
	credit hours =	*0*	*credit hours =*	*10*
Soph	Calc 2	5	Calc 3	3
	Phys 2	5	Stat 290	3
	*[Seminar]	1	Chem 1	4
	credit hours =	*11*	*credit hours =*	*10*
Junior	Mod 1	3	Mod 2	3
	ODE	3	Math Phys	3
	Vibs & Waves	3	Linear	3
	Electronics	3	Junior Seminar	1
			Adv. Lab	3
			Research	1
	credit hours =	*12*	*credit hours =*	*14*
Senior	Classical	3	Thermodynamics	3
	Quantum	3	Adv. Topics	3
	Research	2	E&M	3
			Capstone Sem.	1
	credit hours =	*8*	*credit hours =*	*10*

* The early seminar (PHYS 145) should be taken in the freshman year unless the decision to be a physics major occurs too late. In that case the seminar should be taken in the sophomore year.

Typical Dual Degree Course Sequence

	FALL	credits	SPRING	credits
Fresh	Calc 1	5	Calc 2	5
	Phys 1	5	Chem 1	4
	Seminar	1	Phys 2	5
	credit hours =	*11*	*credit hours =*	*14*
Soph	Calc 3	3	ODE	3
	Vibs & Waves	3	Math Phys	3
	Mod 1	3	Mod 2	3
	credit hours =	*9*	*credit hours =*	*9*
Junior	*Elective	3	Junior Seminar	1
			Adv. Lab	3
			Ad Phys Sem.	1
	credit hours =	*3*	*credit hours =*	*5*

MODEL CURRICULA FOR FIRST TWO YEARS BS or BA PHYSICS STUDENTS (2011-2012)

BS or BA PHYSICS - option 1
(for students ready to take Calculus)

	Course #	Course name	credits
Fall	PHYS 145	Physics Seminar	1
#1	PHYS 195	Physics w/ Calc. I	5
	MATH 198	Calculus I	5
	LSP Course		3
	LSP Course		1 to 3
		TOTAL =	**15 - 17**
Spring	PHYS 196	Physics w/ Calc. II	5
#1	MATH 263	Calculus II	5
	CHEM 130	Gen. Chem I	4
	LSP Course		1 to 3
		TOTAL =	**15 - 17**
Fall	PHYS 250	Modern I	3
#2	PHYS 275	Vibrations & Waves	3
	MATH 264	Calculus III	3
	LSP Course		3 or 4
	LSP Course		1 to 3
		TOTAL =	**13-16**
Spring	PHYS 251	Modern II	3
#2	PHYS 382	Math Physics	3
	MATH 365	Differential Equations	3
	STAT 290	Statistics	3
	LSP Course		3 or 4
		TOTAL =	**15 - 16**

BS or BA PHYSICS - option 2
(for students ready to take Calculus)

	Course #	Course name	credits
Fall	PHYS 145	Physics Seminar	1
#1	PHYS 195	Physics w/ Calc. I	5
	MATH 198	Calculus I	5
	CHEM 130	Gen. Chem I	4
		TOTAL =	**15**
Spring	PHYS 196	Physics w/ Calc. II	5
#1	MATH 263	Calculus II	5
	LSP Course		3 or 4
	LSP Course		1 or 2
		TOTAL =	**14-16**
Fall	PHYS 250	Modern I	3
#2	PHYS 275	Vibrations & Waves	3
	MATH 264	Calculus III	3
	LSP Course		3
	LSP Course		3
		TOTAL =	**15**
Spring	PHYS 251	Modern II	3
#2	PHYS 382	Math Physics	3
	MATH 365	Differential Equations	3
	STAT 290	Statistics	3
	LSP Course		3 or 4
		TOTAL =	**15 - 16**

BS or BA PHYSICS - option 3
(for students **not** ready to take Calculus)

	Course #	Course name	credits
Fall	PHYS 145	Physics Seminar	1
#1	MATH 186	Precalculus	3
	LSP Course		3 or 4
	LSP Course		3
	LSP Course		3
	LSP Course		1 to 3
		TOTAL =	**14 - 17**
Spring	PHYS 195	Physics w/ Calc. I	5
#1	MATH 198	Calculus I	5
	CHEM 130	Gen Chem I	4
	LSP Course		1 to 3
		TOTAL =	**15 - 17**
Fall	PHYS 196	Physics w/ Calc. II	5
#2	MATH 263	Calculus II	5
	STAT 290	Statistics	3
	LSP Course		1 to 3
		TOTAL =	**14 - 16**
Spring	PHYS 382	Math Physics	3
#2	MATH 264	Calculus III	3
	LSP Course		3
	LSP Course		3
	LSP Course		3 or 4
		TOTAL =	**15 - 16**

SPECIAL NOTE for students NOT beginning with either Precalculus or Calculus I: The Physics Programs require a high level of Mathematics; students starting these programs with Algebra should expect their degree program to require more than 8 regular semesters; such students might consider gaining some mathematics credits in summer school and they may consider taking PHYS 100 - CONCEPTS OF PHYSICS (which can only be used as a general elective for Physics majors) to prepare better for future physics courses within the major.

MODEL CURRICULA FOR FIRST TWO YEARS, PRE-ENGINEERING STUDENTS (2011-2012)

Pre-Engineering - option 1
(for students ready to take Calculus)

	Course #	Course name	credits
Fall	PHYS 145	Physics Seminar	1
#1	PHYS 195	Physics w/ Calc. I	5
	MATH 198	Calculus I	5
	ENG 190	Writing	3
		TOTAL =	**14**
Spring	PHYS 196	Physics w/ Calc. II	5
#1	MATH 263	Calculus II	5
	ECON 200 or 201		3
	Social Science Elective		3
		TOTAL =	**16**
Fall	MATH 264	Calculus III	3
#2	CHEM 130	Gen. Chemistry I	4
	COMM 170	Speech	3
	CS 180	Computer Science	3
	ENG ???	Literature elective	3
		TOTAL =	**16**
Spring	MATH 365	Differential Equations	3
#2	STAT 290	Statistics	3
	POL 161	Government	3
	HIST 104/5	US History I or II	3
	elective		3
		TOTAL =	**15**

Pre-Engineering - option 2
(for students **not** ready to take Calculus)

	Course #	Course name	credits
Fall	PHYS 145	Physics Seminar	1
#1	MATH 186	Precalculus	3
	Social Science Elective		3
	ENG 190	Writing	3
	HIST 104/5	US History I or II	3
		TOTAL =	**13**
Spring	PHYS 195	Physics w/ Calc. I	5
#1	MATH 198	Calculus I	5
	COMM 170	Speech	3
	ECON 200 or 202		3
		TOTAL =	**16**
Fall	PHYS 196	Physics w/ Calc. II	5
#2	MATH 263	Calculus II	5
	CS 180	Computer Science	3
	ENG ???	Literature elective	3
		TOTAL =	**16**
Spring			
#2	MATH 264	Calculus III	3
	CHEM 130	Gen. Chemistry I	4
	STAT 290	Statistics	3
	POL 161	Government	3
	elective		3
		TOTAL =	**16**

SPECIAL NOTE for students NOT beginning with either Precalculus or Calculus I: The Pre-Engineering Program requires a high level of Mathematics; students starting these programs with Algebra should expect their degree program to require more than 8 regular semesters; such students might consider gaining some mathematics credits in summer school and they may consider taking PHYS 100 - CONCEPTS OF PHYSICS to prepare better for future physics and engineering courses.

Note: All engineering students are strongly encouraged to consult with the school to which they intend to transfer for precise course requirements for each engineering degree. Certain additional courses may be required and alternatives may be possible.

BA in the Dual Degree Program

	Hours
Liberal Studies Program	**31 – 57**
Missouri Statute Requirement	**1 – 3**
Bachelor of Arts Requirements	**0-6**
Intermediate Proficiency in ONE foreign language	
Required Support	**23**
CHEM 130 General Chemistry I*	4
MATH 198 Analytical Geometry & Calculus I*	5
MATH 263 Analytical Geometry & Calculus II	5
MATH 264 Analytical Geometry & Calculus III	3
MATH 365 Ordinary Differential Equations	3
STAT 290*	3
* May be used to fulfill LSP requirements	
MAJOR REQUIREMENTS	**28**
PHYS 145 Physics Seminar	1
PHYS 195 Physics with Calculus I	5
PHYS 196 Physics with Calculus II	5
PHYS 250 Modern Physics I	3
PHYS 251 Modern Physics II	3
PHYS 275 Vibrations & Waves	3
PHYS 345 Junior Seminar	1
PHYS 382 Mathematical Physics	3
PHYS 388 Advanced Laboratory	3
PHYS 445 Advanced Physics Seminar	1
PHYSICS ELECTIVES	**6**
Upper level engineering courses at an engineering school, as approved by physics faculty at Truman, can be substituted for the following physics electives taught at Truman: PHYS 320 Electronics; PHYS 380 Optics; PHYS 386 Classical Mechanics; PHYS 441, 442, 443 Physics Research; PHYS 482 Electricity and Magnetism; PHYS 486 Thermodynamics and Statistical Mechanics; PHYS 518 Advanced Topics; PHYS 580 Quantum Mechanics.	
LEARNING PLAN	**15**
The Learning Plan courses will be composed of courses taken at an engineering school.	
OTHER ELECTIVES TO TOTAL	**120**

PHYSICS COURSE PREREQUISITES AND OFFERINGS

#	name	prerequisites	co-requisite	recitation?	offered
100	Concepts of Physics			N	Fall, Spring
131	Astronomy I	College Alg & Trig or Math 186		N	Fall & sometimes more
145	Physics Seminar			N	Fall
185	College Physics I	MATH 186 or equiv		N	Fall, Spring
186	College Physics II	185		N	Fall, Spring
195	Physics with Calculus I		Math 198	Y	Fall, Spring
196	Physics with Calculus II	195, Math 198	Math 263	Y	Fall, Spring
208	Design and Drafting			N	rarely
245	Meteorology	College Alg & Trig or Math 186		N	Odd year spring
250	Modern Physics I	196, Math 263		Y	Fall
251	Modern Physics II	250		Y	Spring
275	Vibrations & Waves	196, Math 263		Y	Fall
320	Electronics	196		N	Fall
345	Junior Seminar		251	N	Spring
346	Astronomy II	246		N	rarely
380	Optics	275		Y	rarely
382	Mathematical Physics	196, Math 263		Y	Spring
386	Classical Mechanics	275, 382	Math 365	Y	Fall
388	Advanced Laboratory		250	N	Spring
391	Internship for Physics Majors		392	N	as needed
392	Evaluation and Analysis of Internship		391	N	as needed
441	Physics Research I			N	Fall, Spring, Summer
442	Physics Research II			N	Fall, Spring, Summer
443	Physics Research III			N	Fall, Spring, Summer
444	Independent Studies			N	Fall, Spring, Summer
445	Advanced Physics Seminar	at least junior status; 251, 275, 382		N	Spring
482	Electricity and Magnetism	275, 382; Math 365		Y	Spring
486	Thermodynamics and Stat. Mech.	251, 275, 382; Math 264	Stat 290	Y	Spring
492	Capstone Seminar	*Completed research experience		N	Spring
518	Advanced Topics	251, 275, 382		Maybe	Spring
580	Quantum Mechanics	251, 275, 382		Y	Fall

In all cases the prerequisites mean a grade C or better

*Completed research experience' is at least 3 hours from 441/2/3 OR other approved experience such as a summer REU.

FYI - Math Courses:

186 = Precalculus
198 = Calc 1
263 = Calc 2
264 = Calc 3
365 = Differential Equations