UNDERGRADUATE STUDIES

In

PHYSICS, ASTRONOMY, ASTROPHYSICS, and ENGINEERING PHYSICS

Homer L. Dodge Department of Physics and Astronomy
The University of Oklahoma
Norman, Oklahoma 73019
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University of Oklahoma

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Department of Physics and Astronomy

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Other Nielsen Hall Personnel

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Electrical Engineer	Rusty Boyd
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Program Specialist	Christy Huffman
Research Equipment Specialist	Tetsuya Mishima
Research Scientist/Program Specialist	Horst Severini
Scientist/Researcher	Joel Keay

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PREFACE FROM THE CHAIR

Dear Student,

Undergraduate majors have always been an important and vital part of the Department of Physics and Astronomy. Together with our graduate students, staff, and faculty; you form a community of scholars who learn, practice, enhance, and enjoy physics and astronomy. We welcome you to the Department! We hope that this handbook helps to smooth your progress through your undergraduate studies.

As you make your way through our very fine sequence of formal courses, please also be sure to take advantage of the many opportunities to be involved in world-class research. You will find that research participation will make your physics, astronomy, or engineering physics degree, special!

Sincerely,

Greg Parker, Chair
Homer L. Dodge Department of Physics and Astronomy

DEPARTMENT OF PHYSICS AND ASTRONOMY WEBSITE:

http://www.nhn.ou.edu

UNDERGRADUATE STUDIES COMMITTEE

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Yun Wang
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(Advisor - Astronomy & Astrophysics)

ADVISING

Faculty Advisors

There are three faculty members in the Department, who have primary responsibility for advising undergraduates. At the present time, they are **Dr. Bruce Mason** – Physics, **Dr. Yun Wang** – Astronomy and Astrophysics, and **Dr. Brad Abbott** – Engineering Physics. Like all faculty, they hold regular office hours (posted in the Department office) and will gladly see you by appointment at other times. They are good sources of information and advice.

Registration

Twice a year it will be necessary for you to see an advisor before you register for courses for the next semester. You will be sent an email (to your university email address) from the Department before registration begins reminding you of the procedures. Of course, you are always welcome to see an advisor at any time during the school year. You do not have to wait for a reminder.

University College

If you enter the University as a freshman, your first advisor will probably be a staff member, either from University College or from the OU Scholars - Honors Program. You are a student in University College until you qualify for admission to one of the colleges that actually have academic departments and award degrees. University College merely enrolls and advises new students until they are ready to transfer to another college, usually at the end of their freshman year. **Although your official adviser is in the University College (or OU Scholars/Honors College), we strongly recommend you stop by the department and meet with one of our advisors also. They will be able to answer questions you may have about our program in more depth than University College personnel will.**

After you have met the necessary general requirements, described in detail in the current University of Oklahoma General Catalog, majors in Physics, Astronomy and Astrophysics will transfer to the College of Arts and Sciences; majors in Engineering Physics to the College of Engineering. As with all University regulations, you should make it your business to know what they are. Once you have been transferred, all your advising will normally be done in the Department.

College Advisors

In addition to working with faculty advisors from the department, you will occasionally want to consult an Academic Counselor from your College, either Arts and Sciences or Engineering. The current physics and astronomy advisor for the College of Arts and Sciences is Jennifer Clark in the Hobson Academic Advising Center, 124 Ellison Hall. Jeannine Desmarais in the College of Engineering's Williams Student Services Center (WSSC), in 112 Felgar Hall advises Engineering Physics majors. If you are in the OU Scholar's Program, you will also see advisors in the Honors College. These are all professional staff members whose job it is to maintain your academic records and ultimately to verify that you have satisfied all the requirements for graduation. Once you have reached SENIOR standing [90 credit hours], they will perform, at your request, a "degree-check" for you. They are also a good source of information on University regulations. You can schedule a College advising appointment at: **https://iadvise.ou.edu/**.

Transfer Students

If you transfer to OU from another institution of higher learning and qualify for admission directly to a degree-granting college, you will enter that college instead of University College.

The Admissions Office, during the initial application process, routinely performs an evaluation of your previous coursework using the Computerized Transcript Evaluation System. Courses are evaluated in terms of OU equivalents. For courses without OU equivalents, you should schedule an appointment with one of the Academic Counselors in your College. They may be able to determine transfer credit for particular courses or they will refer you to the appropriate department advisor for a review of the course in question. It will be to your advantage to have course descriptions and syllabi for those courses that must be individually evaluated. Coursework in your major (i.e., physics and astronomy courses) will be evaluated by one of the faculty advisors in our Department. The faculty advisor will also help you select the courses at OU, which will best enable you to fit into one of our programs.

GETTING STARTED IN YOUR MAJOR

The courses required for our majors usually cannot be taken out of sequence; each builds upon the previous course. Moreover, the curriculum is quite full. It is prudent to start the major as early as possible, in order to graduate in a timely fashion. We strongly recommend that majors start taking physics courses in their freshman year, if at all possible.

Physics 1205-1215

Whatever your major emphasis within the Department (Physics, Astronomy, Astrophysics, or Engineering Physics), it is important that you take your first physics courses as soon as possible. Normally, this will be the two-semester sequence Physics 1205-1215 - Introductory Physics for Physics Majors, which is offered once a year beginning in the fall semester. Math 1823 - Calculus & Analytic Geometry I, or Math 1914 – Differential and Integral Calculus I is a co-requisite for Physics 1205. If you enter the University as a freshman, you will have to take a mathematics placement exam. You must test into Math 1823, MATH 1914, or a higher math course in order to enroll in Physics 1205.

Physics 2514-2524

With permission from your advisor, it is also possible to start your physics courses with the two-semester sequence Physics 2514-2524 - General Physics for Engineering and Science Majors. This is a large lecture course taken mainly by engineering students. Since it has no laboratory, you will be required to take two additional hours of physics lab (such as Phys 1311 – General Physics Lab I or PHYS 1321 – General Physics Lab II) or an equivalent before you graduate. Math 1823 – Calculus and Analytical Geometry I, or MATH 1914 – Differential and Integral Calculus I is a **prerequisite** (not a co-requisite) for Physics 2514. Since these courses place more emphasis on practical applications and less on fundamentals, you will get a better start on your major by taking Physics 1205-1215. On the other hand, if for some reason you have already taken Physics 2514-2524 or its equivalent, there is no need to repeat the material. Move ahead to the next level.

Physics 2414-2424

If you have taken these algebra-based introductory physics courses, you should talk to the Undergraduate Studies chair for a recommendation on how to proceed.

CHOOSING YOUR PROGRAM

Major Courses

Whether you choose to major in Physics, Astronomy, Astrophysics, or Engineering Physics your required courses in physics and mathematics will be very similar. In the first two years, they are nearly identical. Over four years, Physics majors take a few more courses in physics and mathematics; and Astronomy/Astrophysics majors take astrophysics courses instead. Engineering Physics majors take, in addition to the physics and math courses, all the engineering courses required for a professional engineering degree. The exact requirements for each degree are given in the pages that follow.

General Education

In addition to the degree requirements specified by the Department, the University requires that all students, whatever their major, take a certain number of courses in general education (e.g. English composition, history, foreign language). These course requirements total about 40 hours, and need to be part of your curriculum planning. A curriculum guideline for each major detailing these general educational requirements is included in this handbook. Consult the University catalog and talk to your advisor for additional details.

Common Degree Requirements

Mathematics – The Language of Physics

You will notice that mathematics is an integral part of the curriculum for all our degree programs from the very beginning. The reason for this is fundamental: mathematics is the language of physics. By this, we do not mean simply that physicists use mathematics to communicate with each other, although they do. We mean that the basic ideas of physics are themselves mathematical. Especially in modern physics, where human intuition often fails, the ideas of physics are inseparable from their mathematical expression. Furthermore, a goal of physics is to make quantitative predictions about the world we live in – predictions subject to observation and measurement. Quantitative predictions require mathematics. The integration of mathematics and physics can be difficult but is absolutely necessary for success in physics.

Laboratory

Another important part of the Physics curriculum is laboratory work. Some of the laboratory work will help you to clarify physics concepts and some will introduce you to experimental techniques and instruments. If you should choose someday to work or teach in experimental physics, your laboratory training will help you directly. However, even if you do not, it is important for every physicist to understand the relationship between physics theory and experimental evidence, and

to appreciate what constitutes a good experiment. Laboratory work is difficult and time-consuming, but essential to your education.

Senior Research Project – The Capstone Experience

All Departmental majors - Physics, Astronomy, Astrophysics and Engineering Physics – in their senior year are required to enroll in Physics 4300 - Senior Research Project. Successful projects will take an academic year to complete, so students will enroll in PHYS 4300 in two consecutive semesters for a total of four credit hours, preferably two hours each semester. This is a research project leading to a written thesis (with a possible exception described below). [Physics 4300 satisfies the University requirement that all undergraduates participate in a "Capstone Experience" in their major.] Each project is under the direction of an individual faculty member, who mentors the student. For Physics and Astronomy majors, the project is typically in physics or astronomy and can be either experimental or theoretical in nature. Engineering physics student **MUST** do a project that involves engineering design and their project and faculty mentor can be in an engineering discipline or in physics. It will be your responsibility to make arrangements with a faculty member, who will serve as a mentor for your project.

Enrollment for this course begins with a visit to the Physics Office for a pink “Authorization To Enroll” slip, which must be signed by the Physics 4300 instructor, currently Prof. Matthew Johnson. Return the signed slip to the Undergraduate Program Coordinator in the Physics Office to get your Physics 4300 enrollment stop lifted.

Each project will culminate in a substantial written product, in the nature of a senior thesis. The thesis will be written so as to be intelligible to other senior physics and astronomy majors not familiar with the research topic. In addition, each student will present an oral report on the project to a seminar consisting of all students enrolled in the course. The seminar will meet regularly to hear and discuss the reports, as well as discuss topics of current interest in physics and astronomy.

Although majors in Physics, Astronomy, and Astrophysics, typically do their Capstone project in physics or astronomy, those students in the College of Arts and Sciences who desire and can profit from an interdisciplinary Capstone experience, may petition our Undergraduate Studies Committee to replace up to three hours of Physics 4300 with an equal number of hours of an advanced course (3000 level or higher) in a complementary scientific discipline that integrates topics from the student's major in a significant way. Approved courses include, but are not limited to, those listed below. One hour of Physics 4300 would still be required, incorporating participation in the seminar, an oral report, and a term paper of at least 25 pages drawing on the material of the complementary course.

Partial List of Approved Courses:

AME	4593	Space Science and Systems
E E	5343	Opto-Electronics
GEOL	5713	Solid Earth Geophysics

Other courses may also be approved. In general, an appropriate course should: 1) have prerequisites, that are substantial but not prohibitive to a non-major; 2) should be sufficiently advanced to prepare a student to write a major term paper; and 3) should incorporate concepts from physics or astronomy.

Students in the Honors College who desire to graduate with Honors – *cum laude, magna cum laude, and suma cum laude* – are required to take Honors Research (e.g. PHYS 3980). These students may substitute an Honors Research course for a portion of their PHYS 4300 requirement. They should check with both the Honors College AND the departmental Honors College faculty advisor, Dr. Michael Strauss, to insure they meet all the requirements to graduate with Honors AND complete their Capstone project.

Take Your Time

One final admonition: TAKE YOUR TIME. Learning in physics cannot be rushed, nor can it be forced. Memorization will not do. Basic understanding to make intellectual connections is required. You must develop a whole new language and learn many new skills. Physics, in particular, takes time to learn because it is hierarchical. Courses are taught in sequence, and topics taught in one course depend on knowledge from another. You will notice that the Department requires a grade of "C" or better in each required course in physics, astronomy, and mathematics. The reason for this is that without at least a "C" in one course, you will not be prepared to succeed in the next course in the sequence. Furthermore, if you want to go to graduate school, you will need at least a "B" average in upper division undergraduate work. It is better to slow down and postpone a course, if necessary, than to get a poor grade. Be sure to talk with your instructor and advisor if you begin to fall behind in a course.

IF YOU CHOOSE PHYSICS

Degree Programs

There are two different degree programs in Physics: the professional degree of **Bachelor of Science in Physics** (major code – **B781**), and the standard degree of **Bachelor of Science** (major code – **B780**). Students planning to continue into graduate study, or who, for any reason, want a comprehensive curriculum, are advised to take the professional degree program. This program can be completed in four years, although some students take five years. Students who want a less comprehensive program may choose the standard degree, which takes less time. It is possible, although we strongly discourage it, to enter graduate school with the standard degree and take the missing courses as a graduate student. With fewer required courses, the standard degree enables a student interest in medicine or law, for example, to take the necessary preparatory courses for a professional program.

Course Requirements

Look over the curriculum guidelines for the two degrees in Physics at the end of this section. They represent carefully designed programs with a definite logical structure. *Courses need to be taken in the sequence shown because each course builds on previous courses.* You will be handicapped if you take them out of order. Except for the calculus courses, the course in Chemistry, Advanced Lab and Capstone, all the courses listed are offered only once a year during the fall or spring semester. Therefore, it is important for you to plan carefully. Special circumstances, especially for transfer students, may occasionally warrant some changes in sequence. This is where advice from the Physics and Astronomy faculty advisor is absolutely necessary. Do not modify these programs without your faculty advisor's consent!

Mathematics - Upper Division

For the Professional Physics degree, mathematics is required through Math 3423 - Physical Mathematics II, and an upper division elective. Good choices for the elective are Math 3333 - Linear Algebra, Math 4103 - Introduction to Functions of a Complex Variable, Math 4653 - Introduction to Differential Geometry, and Math 4073 - Numerical Analysis. In fact, as with physics electives, you will be better prepared for graduate school if you take more math courses than are required. [Majors, who have the complete MATH 3423, can earn a minor in math (Minor Code – **N670**) by taking two additional math courses at the 4000 level or higher.]

Optional Courses

You will notice that a few courses on the curriculum guideline for the professional program are recommended but not required for the degree. If you plan to attend graduate school or perform professional work in physics, you are strongly recommended to take these additional classes. Material from these courses is included in the written qualifying exam required for graduate students in our Department.

CURRICULUM GUIDELINES for STANDARD PHYSICS DEGREE

Bachelor of Science

Degree Code B870

Semester I (Fall)

PHYS 1205 Phys I for Majors
MATH 1823 Calculus & Analytic Geometry I *or*
MATH 1914 Differential and Integral Calculus I

Semester II (Spring)

PHYS 1215 Phys II for Majors
MATH 2423 Calculus & Analytic Geometry II *or*
MATH 2924 Differential and Integral Calculus II
CHEM 1315 General Chemistry
(Only required for those without 1 year of high school chemistry)

Semester III

PHYS 2203 Phys III for Majors: Modern Phy
PHYS 2303 Electronics
MATH 2433 Calculus & Analytic Geometry III *or*
MATH 2934 Differential and Integral Calculus III

Semester IV

PHYS 3043 Physical Mechanics I
MATH 2443 Calculus & Analytic Geometry IV
(Not necessary if taken MATH 2934)
MATH 3413 Physical Math I

Semester V

PHYS 3053 Physical Mechanics II
PHYS 3183 Elec & Magnetism I

Semester VI

PHYS 3302 Advanced Laboratory I
PHYS 3803 Quantum Mechanics I

Semester VII

PHYS 4300 Senior Lab Project (Capstone)
PHYS 3000-4000 (Physics Elective)

Semester VIII

PHYS 4300 Senior Lab Project (Capstone)

Required Hours:	Physics	37	Including a 3-hour elective
	Math	15	
	Chem	5	Or 1 year High-School chemistry
	Gen Ed	40	
	Free Electives	27	32 if chemistry is not needed
		124	

A grade of 'C' or better must be earned in each required Physics and Math course.

REQUIREMENTS FOR THE BACHELOR OF SCIENCE COLLEGE OF ARTS AND SCIENCES
THE UNIVERSITY OF OKLAHOMA

For Students Entering the Oklahoma State System for Higher Education:

Summer 2014 through Spring 2015

Minimum Credit Hours and Grade Point Averages Required			
Total Hours —	120	Upper-Division Within Total	48
Major Hours —	37		
Grade Point Averages:			
Overall & Major: Combined OU/Transfer - 2.00 OU - 2.00			
48 Upper-Division Hours REQUIRED			

Physics

(Standard Option)

B780

Bachelor of Science

OU encourages students to complete at least 30 hours of applicable coursework each year to have the opportunity to graduate in four years.

GENERAL EDUCATION AND COLLEGE REQUIREMENTS
Courses graded P/NP will not apply.

Courses for fulfillment of General Education and College of Arts & Sciences requirements must be from the approved General Education course list published in the Class Schedule or at http://www.ou.edu/enrollment/home/

University-Wide General Education (minimum 40 hours) and College of Arts and Sciences Requirements

Core Area I: Symbolic and Oral Communication (9-22 hours, 3-6 courses)

a. English Composition (6 hours, 2 courses)
   1. English 1113, Principles of English Composition
   2. English 1213, Principles of English Composition, or EXPO 1213, Expository Writing

b. Foreign Language (0-13 hours in the same language)
   The College of Arts and Sciences requirement *cannot be met by high school coursework.*
   1. Beginning Course (0-5 hours) _____
   2. Beginning Course, continued (0-5 hours) _____
   ◆ 3. Intermediate Course (2000 level, 0-3 hours). _____
   One course at the intermediate level or demonstrated competency at that level.

c. Mathematics (3 hours, 1 course). _____

Core Area II: Natural Science (7 hours, 2 courses) including one laboratory component.

◆ 1.Biological Science _____
Chosen from the following approved General Education designators: BIOL, HES, MBIO, or PBIO.

◆ 2.Physical Science _____
Chosen from the following approved General Education designators: AGSC, ASTR, CHEM, GEOG, GEOL, GPHY, METR, or PHYS.

Core Area III: Social Science (6 hours, 2 courses)

1. Political Science 1113, American Federal Government
2. _____

Core Area IV: Humanities (18 hours, 6 courses)

a: Understanding Artistic Forms (3 hours, 1 course) _____

b. Western Civilization and Culture (6 hours, 2 courses)
   1. History 1483, U.S., 1492-1865, or History 1493, U.S., 1865-Present,
   2. _____ (excluding HIST 1483 and 1493)

c. Non-Western Culture (3 hours, 1 course):_____

d. Additional Core IV Humanities courses (6 upper-division hours, 2 courses at the 3000- 4000-level). Must be outside the major and selected from Understanding Artistic Forms, Western Civilization and Culture, or Non-Western Culture.

◆ 1. _____

◆ 2. _____

Core Area V: Senior Capstone Experience (3 hours, 1 course): _____

◆ College of Arts and Sciences Requirements: College requirements are not automatically fulfilled by a previous degree.

Some courses required for the major may also fulfill University General Education and/or College of Arts & Sciences Requirements

A total of 37 hours in Physics is required, including the courses listed below. A grade of C or better must be earned in each required physics and mathematics course.

MAJOR REQUIREMENTS

PHYSICS		
1205	Introductory Physics I for Physics Majors	5
1215	Introductory Physics II for Physics Majors	5
2203	Intro. Physics III: Modern Physics	3
2303	Electronics	3
3043	Physical Mechanics I	3
3053	Physical Mechanics II	3
3183	Electricity & Magnetism I	3
3302	Advanced Laboratory I	2
3803	Introduction to Quantum Mechanics I	3
4300	Senior Research Project (Capstone Course) 4300	2
Senior Research Project (2 enrollments required)		2
One additional Physics course at the 3000-level or above.		
_____		3

MAJOR SUPPORT REQUIREMENTS

CHEMISTRY		
1315	General Chemistry, or One year of high school Chemistry.	0-5
MATHEMATICS		
2443	Calculus & Analytic Geometry IV	3
3413	Physical Mathematics I	3

Free Electives

Electives to bring total applicable hours to 120 including 48 upper-division hours.

2-14

INFORMATION CONCERNING GENERAL RULES, REGULATIONS AND MINIMUM REQUIREMENTS

TOTAL HOURS: A minimum of 120 semester hours acceptable toward graduation must be completed.

UPPER-DIVISION HOURS: A minimum of 48 upper-division semester hours acceptable toward graduation must be completed. OU courses numbered 3000 or above are upper-division. Transfer work is counted as lower-division or upper-division credit depending on the level at which it was offered at the institution where it was earned. Two-year college work is accepted only as lower-division credit.

ARTS AND SCIENCES HOURS: At least 80 semester hours of liberal arts and sciences courses are required for a BA degree. At least 55 semester hours of liberal arts and sciences courses are required for a BS degree.

MAJOR WORK: A minimum of 30 semester hours must be earned in the major, including a minimum of 15 credit hours at the upper-division level.

PASS/NO PASS ENROLLMENT: A maximum of 16 semester hours of free elective credit may be attempted under this option.

INDIVIDUAL STUDIES (e.g., courses titled "Independent Study"): A maximum of 12 total semester hours may be counted toward graduation, excluding Honors Reading and Honors Research.

P.E. COURSES: No physical education activity courses will be counted toward the 120 semester hours of acceptable credit for graduation.

SENIOR INSTITUTION HOURS: A minimum of 60 semester hours applied toward graduation must be earned at senior (4-year) institutions.

RESIDENCY:

- At least 15 of the final 30 hours applied toward the degree or at least 50 percent of the hours required by the institution in the major field must be satisfactorily completed at the awarding institution.
- At least 15 semester hours of upper-division major work must be completed in residence at OU.
- OU correspondence courses are ***not*** considered resident credit.
- Credits earned via examination are neither resident nor nonresident credit.

GRADE POINT AVERAGES: Students must earn a minimum overall 2.00 for each of the following: Combined Retention GPA (all college grades), OU Retention GPA, GPA for all major courses, and GPA for all major courses taken at OU. Some schools and departments of the College have higher minimum grade point averages required for their students.

SPECIAL DEGREES: Students may qualify for an Honors degree (cum Laude, Magna cum Laude, or Summa cum Laude) by completing specific requirements of the Honors College. A degree will be earned with Distinction if the student completes at least 60 semester hours at OU with at least a 3.60 combined retention GPA and OU retention GPA. A degree will be earned with Special Distinction if the student completes at least 60 semester hours at OU with at least a 3.90 combined retention GPA and OU retention GPA.

APPLICATION FOR GRADUATION: Students must apply for graduation during the term in which they complete their degree requirements in order to graduate in that term. The graduation application is available on line on your Ozone site. Deadlines for the OU Graduation Application are: **March 1** for Spring certification and the University of Oklahoma Commencement book; **July 1** for Summer graduation certification; and, **October 1** for Fall graduation certification.

Refer to the OU General Catalog for more complete information.

Suggested Semester Plan of Study — Physics (Standard Option) - B780

This plan shows one possible grouping of courses that would allow students to graduate in four years. Please refer to the front of the degree checksheet for official requirements. Students must consult with College of Arts and Sciences and/or Department of Physics and Astronomy academic advisers to verify that courses selected each semester fulfill the recommended plan and satisfy university, College of Arts and Sciences, and Physics major requirements.

Year	FIRST SEMESTER	Hours	SECOND SEMESTER	Hours
FRESHMAN	ENGL 1113, Principles of English Composition (Core I)	3	ENGL 1213, Principles of English Composition (Core I), or	3
	MATH 1823, Calculus and Analytic Geometry I (Core I) ★	3	EXPO 1213, Expository Writing (Core I)	
	PHYS 1205, Introductory Physics I for Physics Majors	5	MATH 2423, Calculus and Analytic Geometry II ★	3
	Beginning Foreign Language (Core I)	5	PHYS 1215, Introductory Physics II for Physics Majors	5
			Beginning Foreign Language continued (Core I)	5
	TOTAL CREDIT HOURS	16	TOTAL CREDIT HOURS	16
SOPHOMORE	MATH 2433, Calculus and Analytic Geometry III ★	3	HIST 1483, United States 1492-1865, or	3
	PHYS 2203, Introductory Physics III: Modern Physics	3	1493, United States 1865-Present (Core IV)	
	PHYS 2303, Electronics	3	MATH 2443, Calculus and Analytic Geometry IV ★	3
	Intermediate Foreign Language	3	MATH 3413, Physical Mathematics I	3
	Biological Science without lab (Core II)	3	PHYS 3043, Physical Mechanics I	3
			Social Science (Core III)	3
	TOTAL CREDIT HOURS	15	TOTAL CREDIT HOURS	15
JUNIOR	CHEM 1315, General Chemistry	5	PHYS 3803, Introduction to Quantum Mechanics I	3
	P SC 1113, American Federal Government (Core III)	3	PHYS Major Elective, upper-division (3000-4000-level)	3
	PHYS 3053, Physical Mechanics II	3	Understanding Artistic Forms (Core IV)	3
	PHYS 3183, Electricity & Magnetism I	3	Western Civilization & Culture (Core IV)	3
	PHYS 3302, Advanced Lab I	2	Free Elective, upper-division (3000-4000-level)	3
	TOTAL CREDIT HOURS	16	TOTAL CREDIT HOURS	15
SENIOR	PHYS 4300, Senior Research Project (Capstone)	2	PHYS 4300, Senior Research Project (Capstone)	2
	Humanities, upper-division, outside major (Gen. Ed.)	3	Humanities, upper-division, outside major (Gen. Ed.)	3
	Non-Western Culture (Core IV)	3	Free Elective, upper-division (3000-4000-level)	3
	Free Elective, upper-division (3000-4000-level)	3	Free Elective, upper-division (3000-4000-level)	3
	Free Elective, upper-division (3000-4000-level)	3	Free Elective, upper-division (3000-4000-level)	3
	TOTAL CREDIT HOURS	14	TOTAL CREDIT HOURS	14

★ Students may substitute MATH 1914, 2924, and 2934 calculus sequence instead of MATH 1823, 2423, 2433, and 2443.

Bachelor's degrees require a minimum of 48 hours of upper-division (3000-4000) coursework.
This plan of study should not be used in lieu of academic advisement.

Students who transfer from other institutions (particularly community colleges) must verify credit hour and course requirements with their college academic counselor, ELLH 124, 325-4411, http://ou.edu/cas.
Please make an appointment for a degree check with your college academic counselor once you have earned 90 hours. Appointments may be scheduled at https://iadvise.ou.edu/.

CURRICULUM GUIDELINES for PROFESSIONAL PHYSICS DEGREE
Bachelor of Science in Physics

Degree Code B781

Semester I (Fall)

PHYS 1205 Phys I for Majors
MATH 1823 Calculus & Analytic Geometry I
or MATH 1914 Differential & Integral Calculus I

Semester II (Spring)

PHYS 1215 Phys II for Majors
MATH 2423 Calculus & Analytic Geometry II
or MATH 2924 Differential & Integral Calculus II
CHEM 1315 General Chemistry
(Only required for those without 1 year of high School chemistry)

Semester III

PHYS 2203 Phys III for majors: Modern Phys
PHYS 2303 Electronics
MATH 2433 Calculus & Analytic Geometry III
or MATH 2934 Differential & Integral Calculus III

Semester IV

PHYS 3043 Physical Mechanics I
MATH 2443 Calculus & Analytic Geometry IV
(Not necessary if taken MATH 2934)
MATH 3413 Physical Math I

Semester V

PHYS 3053 Physical Mechanics II
PHYS 3183 Elec & Magnetism I
MATH 3423 Physical Math II

Semester VI

PHYS 3302 Advanced Lab I
PHYS 3803 Quantum Mechanics I
*Physics/Math Elective

Semester VII

PHYS 3312 Advanced Lab II
PHYS 4153 Stat Phys-Thermodyn
PHYS 4300 Senior Lab Project (Capstone)
*Physics/Math Elective

Semester VIII

PHYS 4300 Senior Lab Project (Capstone)
*Physics/Math Elective

<u>*Physics/Math Electives</u>

Choose two of the following: 4213 Nuclear Particle Physics, 4243 Solid State Physics, 4813 Atomic Molecular Physics, 4183 Electricity & Magnetism II, and 4803 Quantum Mechanics II

Plus 3 upper division hours of math electives.

Required Hours:	Physics	45	Includes 6 elective hours
	Math	21	
	Chem	5	or 1 year of High School chemistry
	Gen Ed	40	
	Free Electives	<u>13</u>	18 if chemistry is not needed
		124	

A grade of 'C' or better must be earned in each required Physics and Math course.

REQUIREMENTS FOR THE BACHELOR OF SCIENCE IN PHYSICS
COLLEGE OF ARTS AND SCIENCES
THE UNIVERSITY OF OKLAHOMA

For Students Entering the Oklahoma State System for Higher Education:
Summer 2014 through Spring 2015

Minimum Credit Hours and Grade Point Averages Required			
Total Hours —	120	Upper-Division Within Total	48
Major Hours —	45		
Grade Point Averages: Overall & Major: Combined OU/Transfer - 2.00 OU - 2.00			
48 Upper-Division Hours REQUIRED			

Physics
(Professional Option)
B781

Bachelor of Science in Physics

OU encourages students to complete at least 30 hours of applicable coursework each year to have the opportunity to graduate in four years.

GENERAL EDUCATION AND COLLEGE REQUIREMENTS
Courses graded P/NP will not apply.

Courses for fulfillment of General Education and College of Arts & Sciences requirements must be from the approved General Education course list published in the Class Schedule or at http://www.ou.edu/enrollment/home/

University-Wide General Education (minimum 40 hours) and College of Arts and Sciences Requirements

Core Area I: Symbolic and Oral Communication (9-22 hours, 3-6 courses)

a. English Composition (6 hours, 2 courses)
   1. English 1113, Principles of English Composition
   2. English 1213, Principles of English Composition, or EXPO 1213, Expository Writing

b. Foreign Language (0-13 hours in the same language)
   The College of Arts and Sciences requirement *cannot be met by high school coursework.*
   1. Beginning Course (0-5 hours) _____
   2. Beginning Course, continued (0-5 hours) _____
   ◆ 3. Intermediate Course (2000 level, 0-3 hours). _____
   One course at the intermediate level or demonstrated competency at that level.

c. Mathematics (3 hours, 1 course). _____

Core Area II: Natural Science (7 hours, 2 courses) including one laboratory component.

◆ 1. Biological Science _____
Chosen from the following approved General Education designators: BIOL, HES, MBIO, or PBIO.

◆ 2. Physical Science _____
Chosen from the following approved General Education designators: AGSC, ASTR, CHEM, GEOG, GEOL, GPHY, METR, or PHYS.

Core Area III: Social Science (6 hours, 2 courses)

1. Political Science 1113, American Federal Government
2. _____

Core Area IV: Humanities (18 hours, 6 courses)

a: Understanding Artistic Forms (3 hours, 1 course) _____

b. Western Civilization and Culture (6 hours, 2 courses)
   1. History 1483, U.S., 1492-1865, or History 1493, U.S., 1865-Present,
   2. _____ (excluding HIST 1483 and 1493)

c. Non-Western Culture (3 hours, 1 course):_____

d. Additional Core IV Humanities courses (6 upper-division hours, 2 courses at the 3000- 4000-level). Must be outside the major and selected from Understanding Artistic Forms, Western Civilization and Culture, or Non-Western Culture.

◆ 1. _____

◆ 2. _____

Core Area V: Senior Capstone Experience (3 hours, 1 course): _____

◆ College of Arts and Sciences Requirements: College requirements are not automatically fulfilled by a previous degree.

Some courses required for the major may also fulfill University General Education and/or College of Arts & Sciences Requirements

MAJOR REQUIREMENTS

A total of 45 hours in Physics is required, including the courses listed below. A grade of C or better must be earned in each required physics and mathematics course.

PHYSICS

1205	Introductory Physics I for Physics Majors	5
1215	Introductory Physics II for Physics Majors	5
2203	Intro. Physics III: Modern Physics	3
2303	Electronics	3
3043	Physical Mechanics I	3
3053	Physical Mechanics II	3
3183	Electricity & Magnetism I	3
3302	Advanced Lab I	2
3312	Advanced Lab II	2
3803	Introduction to Quantum Mechanics I	3
4153	Statistical Physics and Thermodynamics	3
4300	Senior Research Project (Capstone Course) 4300	2
	Senior Research Project (2 enrollments required)	2

Two of the following:

4183	Electricity & Magnetism II	
4213	Nuclear and Particle Physics	
4243	Solid State Physics	
4803	Intro. to Quantum Mechanics II	
4813	Atomic and Molecular Physics	
	_____	3
	_____	3

Strongly Recommended:

4183 Electricity and Magnetism II

4803 Intro. to Quantum Mechanics II

MAJOR SUPPORT REQUIREMENTS

CHEMISTRY

1315	General Chemistry,	0-5
	or	
	One year of high school chemistry	

MATHEMATICS

2443	Calculus & Analytic Geometry IV	3
3413	Physical Mathematics I	3
3423	Physical Mathematics II	3
	Three upper-division elective hours in mathematics:	
	_____	3

Free Electives

Electives to bring total applicable hours to 120 including 48 upper-division hours.

2-14

INFORMATION CONCERNING GENERAL RULES, REGULATIONS AND MINIMUM REQUIREMENTS

TOTAL HOURS: A minimum of 120 semester hours acceptable toward graduation must be completed.

UPPER-DIVISION HOURS: A minimum of 48 upper-division semester hours acceptable toward graduation must be completed. OU courses numbered 3000 or above are upper-division. Transfer work is counted as lower-division or upper-division credit depending on the level at which it was offered at the institution where it was earned. Two-year college work is accepted only as lower-division credit.

ARTS AND SCIENCES HOURS: At least 80 semester hours of liberal arts and sciences courses are required for a BA degree. At least 55 semester hours of liberal arts and sciences courses are required for a BS degree.

MAJOR WORK: A minimum of 30 semester hours must be earned in the major, including a minimum of 15 credit hours at the upper-division level.

PASS/NO PASS ENROLLMENT: A maximum of 16 semester hours of free elective credit may be attempted under this option.

INDIVIDUAL STUDIES (e.g., courses titled "Independent Study"): A maximum of 12 total semester hours may be counted toward graduation, excluding Honors Reading and Honors Research.

P.E. COURSES: No physical education activity courses will be counted toward the 120 semester hours of acceptable credit for graduation.

SENIOR INSTITUTION HOURS: A minimum of 60 semester hours applied toward graduation must be earned at senior (4-year) institutions.

RESIDENCY:

- At least 15 of the final 30 hours applied toward the degree or at least 50 percent of the hours required by the institution in the major field must be satisfactorily completed at the awarding institution.
- At least 15 semester hours of upper-division major work must be completed in residence at OU.
- OU correspondence courses are ***not*** considered resident credit.
- Credits earned via examination are neither resident nor nonresident credit.

GRADE POINT AVERAGES: Students must earn a minimum overall 2.00 for each of the following: Combined Retention GPA (all college grades), OU Retention GPA, GPA for all major courses, and GPA for all major courses taken at OU. Some schools and departments of the College have higher minimum grade point averages required for their students.

SPECIAL DEGREES: Students may qualify for an Honors degree (cum Laude, Magna cum Laude, or Summa cum Laude) by completing specific requirements of the Honors College. A degree will be earned with Distinction if the student completes at least 60 semester hours at OU with at least a 3.60 combined retention GPA and OU retention GPA. A degree will be earned with Special Distinction if the student completes at least 60 semester hours at OU with at least a 3.90 combined retention GPA and OU retention GPA.

APPLICATION FOR GRADUATION: Students must apply for graduation during the term in which they complete their degree requirements in order to graduate in that term. The graduation application is available on line on your Ozone site. Deadlines for the OU Graduation Application are: **March 1** for Spring certification and the University of Oklahoma Commencement book; **July 1** for Summer graduation certification; and, **October 1** for Fall graduation certification

Refer to the OU General Catalog for more complete information.

Suggested Semester Plan of Study — Physics (Professional Option) - B781

This plan shows one possible grouping of courses that would allow students to graduate in four years. Please refer to the front of the degree checksheet for official requirements. Students must consult with College of Arts and Sciences and/or Department of Physics and Astronomy academic advisers to verify that courses selected each semester fulfill the recommended plan and satisfy university, College of Arts and Sciences, and Physics major requirements.

Year	FIRST SEMESTER	Hours	SECOND SEMESTER	Hours
FRESHMAN	ENGL 1113, Principles of English Composition (Core I)	3	ENGL 1213, Principles of English Composition (Core I), or	3
	MATH 1823, Calculus and Analytic Geometry I (Core I)★	3	EXPO 1213, Expository Writing (Core I)	
	PHYS 1205, Introductory Physics I for Physics Majors	5	MATH 2423, Calculus and Analytic Geometry II★	3
	Beginning Foreign Language (Core I)	5	PHYS 1215, Introductory Physics II for Physics Majors	5
			Beginning Foreign Language continued (Core I)	5
	TOTAL CREDIT HOURS	16	TOTAL CREDIT HOURS	16
SOPHOMORE	MATH 2433, Calculus and Analytic Geometry III★	3	CHEM 1315, General Chemistry	5
	PHYS 2203, Introductory Physics III: Modern Physics	3	HIST 1483, United States 1492-1865, or	3
	PHYS 2303, Electronics	3	1493, United States 1865-Present (Core IV)	
	Intermediate Foreign Language	3	MATH 2443, Calculus and Analytic Geometry IV★	3
	Biological Science without lab (Core II)	3	MATH 3413, Physical Mathematics I	3
			PHYS 3043, Physical Mechanics I	3
	TOTAL CREDIT HOURS	15	TOTAL CREDIT HOURS	17
JUNIOR	MATH 3423, Physical Mathematics II	3	MATH Support Elective, upper-division (3000-4000-level)	3
	PHYS 3053, Physical Mechanics II	3	PHYS 3312, Advanced Lab II	2
	PHYS 3183, Electricity & Magnetism I	3	PHYS 3803, Introduction to Quantum Mechanics I	3
	PHYS 3302, Advanced Lab I	2	PHYS Major Elective, 4000-level	3
	Understanding Artistic Forms (Core IV)	3	Western Civilization & Culture (Core IV)	3
	TOTAL CREDIT HOURS	14	TOTAL CREDIT HOURS	14
SENIOR	PHYS 4153, Statistical Physics and Thermodynamics	3	PHYS 4300, Senior Research Project (Capstone)	2
	PHYS 4300, Senior Research Project (Capstone)	2	P SC 1113, American Federal Government (Core III)	3
	PHYS Major Elective, 4000-level	3	Humanities, upper-division, outside major (Gen. Ed.)	3
	Humanities, upper-division, outside major (Gen. Ed.)	3	Social Science (Core III)	3
	Non-Western Culture (Core IV)	3	Free Elective, upper-division (3000-4000-level)	3
	Free Elective, upper-division (3000-4000-level)	3		
	TOTAL CREDIT HOURS	17	TOTAL CREDIT HOURS	14

★ Students may substitute MATH 1914, 2924, and 2934 calculus sequence instead of MATH 1823, 2423, 2433, and 2443.

Bachelor's degrees require a minimum of 48 hours of upper-division (3000-4000) coursework.
This plan of study should not be used in lieu of academic advisement.

Students who transfer from other institutions (particularly community colleges) must verify credit hour and course requirements with their college academic counselor, ELLH 124, 325-4411, http://ou.edu/cas.
Please make an appointment for a degree check with your college academic counselor once you have earned 90 hours. Appointments may be scheduled at https://iadvise.ou.edu/.

IF YOU CHOOSE ASTRONOMY OR ASTROPHYSICS

Degree Programs

The enormous scientific developments in this century have brought astronomy closer to physics. Now, it is no longer limited to a field of research, but it can be considered a branch of physics. It is the application of physics to astronomical phenomena. Mathematics is important in astronomy and astrophysics too.

There are two different degree programs in Astronomy/Astrophysics: one is the professional degree called **Bachelor of Science in Astrophysics** (Major Code – **B082**), and the other is the standard degree in Astronomy called **Bachelor of Science** (Major Code – **B080**). Students who intend to go to graduate school and become professional astronomers will need the professional degree in Astrophysics. The standard degree comprises a rigorous introduction to astronomy for students who plan other pursuits after graduation. Both programs include a substantial number of courses in math and physics as well as astronomy. Curriculum guidelines for both degrees are at the end of this section.

Course Requirements

Many of the comments from the section, "CHOOSING YOUR PROGRAM" and "IF YOU CHOOSE PHYSICS," pertain to Astrophysics and Astronomy as well. The courses are hierarchical; each course depends on its predecessors. The program cannot be rushed. The courses are offered only once a year, in the semester indicated on the course listings. The backbone of the astronomy for both degrees is the required sequence: ASTR 2513 – Introductory Astrophysics/Observatory Methods, ASTR 3103 – Stars, and ASTR 3113 – Galaxies and Cosmology. These courses offer an overview of the Universe, from the solar system to extragalactic astronomy, using calculus and basic physics. ASTR 4303 – Stellar Astrophysics (the study of stellar interiors and stellar evolution) is required of Astrophysics majors but not Astronomy majors. An additional 3-credit hour elective is required for Astrophysics majors. It may be one of the following: MATH 3423 – Physical MATH II, PHYS 4813 – Electricity & Magnetism II, PHYS 4803 – Quantum Mechanics II or a graduate ASTR class. We strongly recommend that Astrophysics majors take additional electives from this list. For both degrees, you undergraduate studies will conclude with four hours of PHYS 4300 – Senior Research Project. This will be a project, theoretical or observational, with one of the Astronomy faculty, to satisfy the general educational requirement for the “Capstone Experience” for your major.

Optional Courses

Some Astronomy courses are offered but not required. ASTR 1504 – General Astronomy and ASTR 1523 – Life in the Universe, provide descriptive introductions to astronomy and astrobiology, respectively that fulfill a general education requirement. They can NOT be used for major credit. We strongly recommend that Astrophysics majors take additional physics and math elective courses, including, in particular, MATH 3423 – Physical MATH II, PHYS 4813 – Electricity &

Magnetism II, PHYS 4803 – Quantum Mechanics II. These will be useful for graduate school. ASTR 4523/5523 – Advanced Observatory Methods is an elective course offered every spring. ASTR 5523 is one of the several graduate courses that can be used to fulfill the astrophysics elective. Other special topics courses may be offered on occasion.

CURRICULUM GUIDELINES for ASTRONOMY DEGREE

Bachelor of Science

Degree Code B080

Semester I (Fall)

PHYS 1205 Phys I for Majors
MATH 1823 Calculus & Analytic Geometry I
or MATH 1914 Differential & Integral Calculus I

Semester II (Spring)

PHYS 1215 Phys II for Majors
MATH 2423 Calculus & Analytic Geometry II
or MATH 2924 Differential & Integral Calculus II
CHEM 1315 General Chemistry

Semester III

PHYS 2203 Phys III for Majors: Modern Phys
MATH 2433 Calculus & Analytic Geometry III
or MATH 2934 Differential & Integral Calculus III
ASTR 2513 Introductory Astrophysics/ Observatory Methods

Semester IV

MATH 2443 Calculus & Analytic Geometry IV (not necessary if taken MATH 2934)
MATH 3413 Physical Math I
PHYS 3043 Physical Mechanics I

Semester V

ASTR 3103 Stars
PHYS 3053 Physical Mechanics II

Semester VI

ASTR 3113 Galaxies & Cosmology
Physics/History of Science Elective

Semester VII

PHYS 4300 Senior Lab Project (Capstone)
Physics/History of Science Elective

Semester VIII

PHYS 4300 Senior Lab Project (Capstone)

Required Hours:	Physics	23
	Astronomy	9
	Math	15
	Chem	5
	Gen Ed	40
	Physics/HSCI Elective	3
	Free Electives	29
		124

A grade of 'C' or better must be earned in each required Physics and Math course.

REQUIREMENTS FOR THE BACHELOR OF SCIENCE
COLLEGE OF ARTS AND SCIENCES
THE UNIVERSITY OF OKLAHOMA

For Students Entering the Oklahoma State System for Higher Education:
Summer 2014 through Spring 2015

Minimum Credit Hours and Grade Point Averages Required			
Total Hours —	120	Upper-Division Within Total	48
Major Hours —	35		
Grade Point Averages:			
Overall & Major: Combined OU/Transfer - 2.00 OU - 2.00			
48 Upper-Division Hours REQUIRED			

Astronomy

B080

Bachelor of Science

OU encourages students to complete at least 30 hours of applicable coursework each year to have the opportunity to graduate in four years.

GENERAL EDUCATION AND COLLEGE REQUIREMENTS
Courses graded P/NP will not apply.

Courses for fulfillment of General Education and College of Arts & Sciences requirements must be from the approved General Education course list published in the Class Schedule or at http://www.ou.edu/enrollment/home/.

University-Wide General Education (minimum 40 hours) and College of Arts and Sciences Requirements

Core Area I: Symbolic and Oral Communication (9-22 hours, 3-6 courses)

a. English Composition (6 hours, 2 courses)
   1. English 1113, Principles of English Composition
   2. English 1213, Principles of English Composition. or EXPO 1213, Expository Writing

b. Foreign Language (0-13 hours in the same language)
   The College of Arts and Sciences requirement *cannot be met by high school coursework.*
   1. Beginning Course (0-5 hours) _____
   2. Beginning Course, continued (0-5 hours) _____
   ◆ 3. Intermediate Course (2000 level, 0-3 hours). _____
   One course at the intermediate level or demonstrated competency at that level.

c. Mathematics (3 hours, 1 course). _____

Core Area II: Natural Science (7 hours, 2 courses) including one laboratory component.

◆ 1.Biological Science _____
Chosen from the following approved General Education designators: BIOL, HES, MBIO, or PBIO.

◆ 2.Physical Science _____
Chosen from the following approved General Education designators: AGSC, ASTR, CHEM, GEOG, GEOL, GPHY, METR, or PHYS.

Core Area III: Social Science (6 hours, 2 courses)

1. Political Science 1113, American Federal Government
2. _____

Core Area IV: Humanities (18 hours, 6 courses)

a: Understanding Artistic Forms (3 hours, 1 course) _____

b. Western Civilization and Culture (6 hours, 2 courses)
   1. History 1483, U.S., 1492-1865, or History 1493, U.S., 1865-Present,
   2. _____ (excluding HIST 1483 and 1493)

c. Non-Western Culture (3 hours, 1 course):_____

d. Additional Core IV Humanities courses (6 upper-division hours, 2 courses at the 3000- 4000-level). Must be outside the major and selected from Understanding Artistic Forms, Western Civilization and Culture, or Non-Western Culture.

◆ 1. _____

◆ 2. _____

Core Area V: Senior Capstone Experience (3 hours, 1 course): _____

◆ College of Arts and Sciences Requirements: College requirements are not automatically fulfilled by a previous degree.

Some courses required for the major may also fulfill University General Education and/or College of Arts & Sciences Requirements

A grade of C or better must be earned in each required astronomy and physics course and in the required mathematics courses.

MAJOR REQUIREMENTS

ASTRONOMY		
2513	Introductory Astrophysics	3
3103	Stars	3
3113	Galaxies and Cosmology	3
PHYSICS		
1205	Introductory Physics I for Physics Majors	5
1215	Introductory Physics II for Physics Majors	5
2203	Intro. Physics III: Modern Physics	3
3043	Physical Mechanics I	3
3053	Physical Mechanics II	3
4300	Senior Research Project (Senior Capstone Course)	2
4300	Senior Research Project (2 enrollments required)	2
One of the following:		
HSCI	3013, History of Science to the Age of Newton	
HSCI	3023, History of Science since the Seventeenth Century	
PHYSICS course at the 3000-level or higher		
_____		3

MAJOR SUPPORT REQUIREMENTS

CHEM	1315 General Chemistry	5
MATH	2443 Calculus & Analytic Geometry IV	3
MATH	3413 Physical Math I	3

Free Electives

Electives to bring total applicable hours to 120 including 48 upper-division hours.

2-14

INFORMATION CONCERNING GENERAL RULES, REGULATIONS AND MINIMUM REQUIREMENTS

TOTAL HOURS: A minimum of 120 semester hours acceptable toward graduation must be completed.

UPPER-DIVISION HOURS: A minimum of 48 upper-division semester hours acceptable toward graduation must be completed. OU courses numbered 3000 or above are upper-division. Transfer work is counted as lower-division or upper-division credit depending on the level at which it was offered at the institution where it was earned. Two-year college work is accepted only as lower-division credit.

ARTS AND SCIENCES HOURS: At least 80 semester hours of liberal arts and sciences courses are required for a BA degree. At least 55 semester hours of liberal arts and sciences courses are required for a BS degree.

MAJOR WORK: A minimum of 30 semester hours must be earned in the major, including a minimum of 15 credit hours at the upper-division level.

PASS/NO PASS ENROLLMENT: A maximum of 16 semester hours of free elective credit may be attempted under this option.

INDIVIDUAL STUDIES (e.g., courses titled "Independent Study"): A maximum of 12 total semester hours may be counted toward graduation, excluding Honors Reading and Honors Research.

P.E. COURSES: No physical education activity courses will be counted toward the 120 semester hours of acceptable credit for graduation.

SENIOR INSTITUTION HOURS: A minimum of 60 semester hours applied toward graduation must be earned at senior (4-year) institutions.

RESIDENCY:

- At least 15 of the final 30 hours applied toward the degree or at least 50 percent of the hours required by the institution in the major field must be satisfactorily completed at the awarding institution.
- At least 15 semester hours of upper-division major work must be completed in residence at OU.
- OU correspondence courses are ***not*** considered resident credit.
- Credits earned via examination are neither resident nor nonresident credit.

GRADE POINT AVERAGES: Students must earn a minimum overall 2.00 for each of the following: Combined Retention GPA (all college grades), OU Retention GPA, GPA for all major courses, and GPA for all major courses taken at OU. Some schools and departments of the College have higher minimum grade point averages required for their students.

SPECIAL DEGREES: Students may qualify for an Honors degree (cum Laude, Magna cum Laude, or Summa cum Laude) by completing specific requirements of the Honors College. A degree will be earned with Distinction if the student completes at least 60 semester hours at OU with at least a 3.60 combined retention GPA and OU retention GPA. A degree will be earned with Special Distinction if the student completes at least 60 semester hours at OU with at least a 3.90 combined retention GPA and OU retention GPA.

APPLICATION FOR GRADUATION: Students must apply for graduation during the term in which they complete their degree requirements in order to graduate in that term. The graduation application is available on line on your Ozone site. Deadlines for the OU Graduation Application are: **March 1** for Spring certification and the University of Oklahoma Commencement book; **July 1** for Summer graduation certification; and, **October 1** for Fall graduation certification

Refer to the OU General Catalog for more complete information.

Suggested Semester Plan of Study — Astronomy - B080

This plan shows one possible grouping of courses that would allow students to graduate in four years. Please refer to the front of the degree checksheet for official requirements. Students must consult with College of Arts and Sciences and/or Department of Physics and Astronomy academic advisers to verify that courses selected each semester fulfill the recommended plan and satisfy university, College of Arts and Sciences, and Astronomy major requirements.

Year	FIRST SEMESTER	Hours	SECOND SEMESTER	Hours
FRESHMAN	ENGL 1113, Principles of English Composition (Core I)	3	CHEM 1315, General Chemistry	5
	MATH 1823, Calculus & Analytic Geometry I (Core I)	3	MATH 2423, Calculus & Analytic Geometry II	3
	PHYS 1205, Introductory Physics I for Physics Majors	5	PHYS 1215, Intro. Physics II for Physics Majors	5
	Beginning Foreign Language (Core I)	5	Beginning Foreign Language continued (Core I)	5
	TOTAL CREDIT HOURS	16	TOTAL CREDIT HOURS	18
SOPHOMORE	ASTR 2513, Introductory Astrophysics	3	HIST 1483, United States 1492-1865, or	3
	ENGL 1213, Principles of English Composition (Core I), or	3	1493, United States 1865-Present (Core IV)	
	EXPO 1213, Expository Writing (Core I)		MATH 2443, Calculus & Analytic Geometry IV	3
	MATH 2433, Calculus & Analytic Geometry III	3	MATH 3413, Physical Mathematics I	3
	PHYS 2203, Intro. Physics III: Modern Physics Intermediate	3	PHYS 3043, Physical Mechanics I	3
	Foreign Language	3	Social Science (Core III)	3
	TOTAL CREDIT HOURS	15	TOTAL CREDIT HOURS	15
JUNIOR	ASTR 3103, Stars	3	ASTR 3113, Galaxies and Cosmology	3
	P SC 1113, American Federal Government (Core III)	3	PHYS Major Elective, upper-division (3000-4000-level), or	3
	PHYS 3053, Physical Mechanics II	3	HSCI 3013, History of Science to the Age of Newton, or	
	Understanding Artistic Forms (Core IV)	3	HSCI 3023, History of Science since the Seventeenth Century	
	Free Elective, upper-division (3000-4000-level)	3	Western Civilization & Culture (Core IV)	3
			Free Elective, upper-division (3000-4000-level)	3
			Free Elective, upper-division (3000-4000-level)	3
	TOTAL CREDIT HOURS	15	TOTAL CREDIT HOURS	15
SENIOR	PHYS 4300, Senior Research Project (Capstone)	2	PHYS 4300, Senior Research Project (Capstone)	2
	Biological Science without lab (Core II)	3	Humanities, upper-division, outside major (Gen. Ed.)	3
	Humanities, upper-division, outside major (Gen. Ed.)	3	Free Elective, upper-division (3000-4000-level)	3
	Non-Western Culture (Core IV)	3	Free Elective, upper-division (3000-4000-level)	3
	Free Elective, upper-division (3000-4000-level)	3	Free Elective, upper-division (3000-4000-level)	3
	TOTAL CREDIT HOURS	14	TOTAL CREDIT HOURS	14

Bachelor's degrees require a minimum of 48 hours of upper-division (3000-4000) coursework.
This plan of study should not be used in lieu of academic advisement.

Students who transfer from other institutions (particularly community colleges) must verify credit hour and course requirements with their college academic counselor, ELLH 124, 325-4411, http://ou.edu/cas.
Please make an appointment for a degree check with your college academic counselor once you have earned 90 hours. Appointments may be scheduled at https://iadvise.ou.edu/.

CURRICULUM GUIDELINES for ASTROPHYSICS DEGREE
Bachelor of Science in Astrophysics

Degree Code B082

Semester I (Fall)

PHYS 1205 Phys I for Majors
MATH 1823 Calculus & Analytic Geometry I
or MATH 1914 Differential & Integral Calculus I

Semester II (Spring)

PHYS 1215 Phys II for Majors
MATH 2423 Calculus & Analytic Geometry II
or MATH 2924 Differential & Integral Calculus II

Semester III

PHYS 2203 Phys III for Majors: Modern Phys
MATH 2433 Calculus & Analytic Geometry III
or MATH 2934 Differential & Integral Calculus III
ASTR 2513 Introductory Astrophysics/ Observatory Methods

Semester IV

PHYS 3043 Physical Mechanics I
MATH 3413 Physical Math I
MATH 2443 Calculus & Analytic Geometry IV
(Not necessary if taken MATH 2934)

Semester V

PHYS 3053 Physical Mechanics II
PHYS 3183 Elec & Magnetism I
ASTR 3103 Stars

Semester VI

PHYS 3803 Quantum Mechanics I
PHYS 3302 Advanced Lab I
ASTR 3113 Galaxies & Cosmology

Semester VII

ASTR 4303 Stellar Astrophys
PHYS 4300 Senior Lab Project (Capstone)
PHYS 4153 Stat Phys-Thermodynamics

Semester VIII

PHYS 4300 Senior Lab Project (Capstone)
Astro/Physics/Math Elective

Elective
Choose one of the following: Math 3243 Physical Math II, Phys 4183 Electricity & Magnetism II, Phys 4803 Quantum Mechanics II or graduate ASTR class.

Required Hours:	Physics	34
	Astronomy	12
	Math	15
	Gen Ed	40
	Phys/Astro/Math	3
	Free Electives	15
		124

A grade of 'C' or better must be earned in each required Physics and Math course.

REQUIREMENTS FOR THE BACHELOR OF SCIENCE IN ASTROPHYSICS

COLLEGE OF ARTS AND SCIENCES

THE UNIVERSITY OF OKLAHOMA

For Students Entering the Oklahoma State System for Higher Education:

Summer 2014 through Spring 2015

Minimum Credit Hours and Grade Point Averages Required			
Total Hours —	120	Upper-Division Within Total	48
Major Hours —	49		
Grade Point Averages:			
Overall & Major: Combined OU/Transfer - 2.00 OU - 2.00			
48 Upper-Division Hours REQUIRED			

Astrophysics

B082

Bachelor of Science in Astrophysics

OU encourages students to complete at least 30 hours of applicable coursework each year to have the opportunity to graduate in four years.

GENERAL EDUCATION AND COLLEGE REQUIREMENTS
Courses graded P/NP will not apply.

Courses for fulfillment of General Education and College of Arts & Sciences requirements must be from the approved General Education course list published in the Class Schedule or at http://www.ou.edu/enrollment/home/.

University-Wide General Education (minimum 40 hours) and College of Arts and Sciences Requirements

Core Area I: Symbolic and Oral Communication (9-22 hours, 3-6 courses)

a. English Composition (6 hours, 2 courses)
   1. English 1113, Principles of English Composition
   2. English 1213, Principles of English Composition, or EXPO 1213, Expository Writing

b. Foreign Language (0-13 hours in the same language)
   The College of Arts and Sciences requirement *cannot be met by high school coursework.*
   1. Beginning Course (0-5 hours) _____
   2. Beginning Course, continued (0-5 hours) _____
   ◆ 3. Intermediate Course (2000 level, 0-3 hours). _____
   One course at the intermediate level or demonstrated competency at that level.

c. Mathematics (3 hours, 1 course). _____

Core Area II: Natural Science (7 hours, 2 courses) including one laboratory component.

◆ 1.Biological Science _____
Chosen from the following approved General Education designators: BIOL, HES, MBIO, or PBIO.

◆ 2.Physical Science _____
Chosen from the following approved General Education designators: AGSC, ASTR, CHEM, GEOG, GEOL, GPHY, METR, or PHYS.

Core Area III: Social Science (6 hours, 2 courses)

1. Political Science 1113, American Federal Government
2. _____

Core Area IV: Humanities (18 hours, 6 courses)

a: Understanding Artistic Forms (3 hours, 1 course) _____

b. Western Civilization and Culture (6 hours, 2 courses)
   1. History 1483, U.S., 1492-1865, or History 1493, U.S., 1865-Present,
   2. _____ (excluding HIST 1483 and 1493)

c. Non-Western Culture (3 hours, 1 course):_____

d. Additional Core IV Humanities courses (6 upper-division hours, 2 courses at the 3000- 4000-level). Must be outside the major and selected from Understanding Artistic Forms, Western Civilization and Culture, or Non-Western Culture.

◆ 1. _____

◆ 2. _____

Core Area V: Senior Capstone Experience (3 hours, 1 course): _____

◆ College of Arts and Sciences Requirements: College requirements are not automatically fulfilled by a previous degree.

Some courses required for the major may also fulfill University General Education and/or College of Arts & Sciences Requirements

A grade of C or better must be earned in each required astronomy and physics course and in the required mathematics courses.

MAJOR REQUIREMENTS

ASTRONOMY

2513	Introductory Astrophysics	3
3103	Stars	3
3113	Galaxies and Cosmology	3
4303	Stellar Astrophysics	3

PHYSICS

1205	Introductory Physics I for Physics Majors	5
1215	Introductory Physics II for Physics Majors	5
2203	Intro. Physics III: Modern Physics	3
3043	Physical Mechanics I	3
3053	Physical Mechanics II	3
3183	Electricity & Magnetism I	3
3302	Advanced Laboratory I, or	
3312	Advanced Laboratory II	
	_____	2
3803	Introduction to Quantum Mechanics I	3
4153	Statistical Physics & Thermodynamics	3
4300	Senior Research Project (Senior Capstone Course)	2
4300	Senior Research Project (2 enrollments required)	2

One of the following:
MATH 3423, Physical Mathematics II
PHYS 4183, Electricity & Magnetism II
PHYS 4803, Intro. to Quantum Mech. II
An astronomy course at the 5000-level.

_____ 3

Strongly Recommended:
4183 Electricity and Magnetism II
4803 Intro. to Quantum Mechanics II
An astronomy course at the 5000-level.

MAJOR SUPPORT REQUIREMENTS

MATH 2443	Calculus & Analytic Geometry IV	3
MATH 3413	Physical Math I	3

Free Electives

Electives to bring total applicable hours to 120 including 48 upper-division hours.

2-14

INFORMATION CONCERNING GENERAL RULES, REGULATIONS AND MINIMUM REQUIREMENTS

TOTAL HOURS: A minimum of 120 semester hours acceptable toward graduation must be completed.

UPPER-DIVISION HOURS: A minimum of 48 upper-division semester hours acceptable toward graduation must be completed. OU courses numbered 3000 or above are upper-division. Transfer work is counted as lower-division or upper-division credit depending on the level at which it was offered at the institution where it was earned. Two-year college work is accepted only as lower-division credit.

ARTS AND SCIENCES HOURS: At least 80 semester hours of liberal arts and sciences courses are required for a BA degree. At least 55 semester hours of liberal arts and sciences courses are required for a BS degree.

MAJOR WORK: A minimum of 30 semester hours must be earned in the major, including a minimum of 15 credit hours at the upper-division level.

PASS/NO PASS ENROLLMENT: A maximum of 16 semester hours of free elective credit may be attempted under this option.

INDIVIDUAL STUDIES (e.g., courses titled "Independent Study"): A maximum of 12 total semester hours may be counted toward graduation, excluding Honors Reading and Honors Research.

P.E. COURSES: No physical education activity courses will be counted toward the 120 semester hours of acceptable credit for graduation.

SENIOR INSTITUTION HOURS: A minimum of 60 semester hours applied toward graduation must be earned at senior (4-year) institutions.

RESIDENCY:

- At least 15 of the final 30 hours applied toward the degree or at least 50 percent of the hours required by the institution in the major field must be satisfactorily completed at the awarding institution.
- At least 15 semester hours of upper-division major work must be completed in residence at OU.
- OU correspondence courses are ***not*** considered resident credit.
- Credits earned via examination are neither resident nor nonresident credit.

GRADE POINT AVERAGES: Students must earn a minimum overall 2.00 for each of the following: Combined Retention GPA (all college grades), OU Retention GPA, GPA for all major courses, and GPA for all major courses taken at OU. Some schools and departments of the College have higher minimum grade point averages required for their students.

SPECIAL DEGREES: Students may qualify for an Honors degree (cum Laude, Magna cum Laude, or Summa cum Laude) by completing specific requirements of the Honors College. A degree will be earned with Distinction if the student completes at least 60 semester hours at OU with at least a 3.60 combined retention GPA and OU retention GPA. A degree will be earned with Special Distinction if the student completes at least 60 semester hours at OU with at least a 3.90 combined retention GPA and OU retention GPA.

APPLICATION FOR GRADUATION: Students must apply for graduation during the term in which they complete their degree requirements in order to graduate in that term. The graduation application is available on line on your Ozone site. Deadlines for the OU Graduation Application are: **March 1** for Spring certification and the University of Oklahoma Commencement book; **July 1** for Summer graduation certification; and, **October 1** for Fall graduation certification.

Refer to the OU General Catalog for more complete information.

Suggested Semester Plan of Study — Astrophysics - B082

This plan shows one possible grouping of courses that would allow students to graduate in four years. Please refer to the front of the degree checksheet for official requirements. Students must consult with College of Arts and Sciences and/or Department of Physics and Astronomy academic advisers to verify that courses selected each semester fulfill the recommended plan and satisfy university, College of Arts and Sciences, and Astrophysics major requirements.

Year	FIRST SEMESTER	Hours	SECOND SEMESTER	Hours
FRESHMAN	ENGL 1113, Principles of English Composition (Core I)	3	ENGL 1213, Principles of English Composition (Core I), or	3
	MATH 1823, Calculus & Analytic Geometry I (Core I)	3	EXPO 1213, Expository Writing (Core I)	
	PHYS 1205, Introductory Physics I for Physics Majors	5	MATH 2423, Calculus & Analytic Geometry II	3
	Beginning Foreign Language (Core I)	5	PHYS 1215, Intro. Physics II for Physics Majors	5
			Beginning Foreign Language continued (Core I)	5
	TOTAL CREDIT HOURS	16	TOTAL CREDIT HOURS	16
SOPHOMORE	ASTR 2513, Introductory Astrophysics	3	HIST 1483, United States 1492-1865, or	3
	MATH 2433, Calculus & Analytic Geometry III	3	1493, United States 1865-Present (Core IV)	
	PHYS 2203, Intro. Physics III: Modern Physics	3	MATH 2443, Calculus & Analytic Geometry IV	3
	Biological Science without lab (Core II)	3	MATH 3413, Physical Mathematics I	3
	Intermediate Foreign Language	3	PHYS 3043, Physical Mechanics I	3
			Social Science (Core III)	3
	TOTAL CREDIT HOURS	15	TOTAL CREDIT HOURS	15
JUNIOR	ASTR 3103, Stars	3	ASTR 3113, Galaxies and Cosmology	3
	P SC 1113, American Federal Government (Core III)	3	PHYS 3302, Advanced Laboratory I, or	2
	PHYS 3053, Physical Mechanics II	3	3312, Advanced Laboratory II	
	PHYS 3183, Electricity and Magnetism IUnderstanding	3	PHYS 3803, Intro. to Quantum Mechanics I	3
	Artistic Forms (Core IV)	3	Western Civilization & Culture (Core IV)	3
			Free Elective, upper-division (3000-4000-level)	3
	TOTAL CREDIT HOURS	15	TOTAL CREDIT HOURS	14
SENIOR	ASTR 4303, Stellar Astrophysics	3	PHYS 4300, Senior Research Project (Capstone)	2
	PHYS 4153, Statistical Mechanics	3	Astrophysics Major Elective, upper-division (3000-4000-level)	3
	PHYS 4300, Senior Research Project (Capstone)	2	Humanities, upper-division, outside major (Gen. Ed.)	3
	Humanities, upper-division, outside major (Gen. Ed.)	3	Free Elective, lower- or upper-division	2
	Non-Western Culture (Core IV)	3	Free Elective, lower- or upper-division	3
			Free Elective, upper-division (3000-4000-level)	3
	TOTAL CREDIT HOURS	14	TOTAL CREDIT HOURS	16

Bachelor's degrees require a minimum of 48 hours of upper-division (3000-4000) coursework.
This plan of study should not be used in lieu of academic advisement.

Students who transfer from other institutions (particularly community colleges) must verify credit hour and course requirements with their college academic counselor, ELLH 124, 325-4411, http://ou.edu/cas.
Please make an appointment for a degree check with your college academic counselor once you have earned 90 hours. Appointments may be scheduled at https://iadvise.ou.edu/.

IF YOU CHOOSE ENGINEERING PHYSICS

Bachelor of Science in Engineering Physics

Degree Code – B372

The **Mission** of the Engineering Physics Program is to prepare students for careers in areas of technology where the disciplines of physics and engineering intersect. The Program provides an interdisciplinary environment where pure and applied science merge. The curriculum is designed to develop sufficient depth in both engineering skills and physics knowledge to produce engineers who are able to relate fundamental physical principles to practical problems in engineering.

The Engineering Physics Program expects its majors to attain the following **Program Educational Objectives** within a few years of graduation:

Objective 1: *Our graduates will pursue careers as engineers, as physicists, or in other fields where an education in Engineering Physics is advantageous.*

Objective 2: *Our graduates will be effective problem solvers in their chosen career paths.*

Objective 3: *Our graduates will engage in life-long learning and professional development activities.*

In attaining these objectives, graduates will be able to contribute to new fields as they emerge. To prepare Engineering Physics majors for pursuit of the program educational objectives, the curriculum is designed to include the following

Student Outcomes:

(a) an ability to apply knowledge of mathematics, science, and engineering;
(b) an ability to design and conduct experiments, as well as to analyze and interpret data;
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
(d) an ability to function on multidisciplinary teams;
(e) an ability to identify, formulate, and solve engineering problems;
(f) an understanding of professional and ethical responsibility;
(g) an ability to communicate effectively;
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
(i) a recognition of the need for, and an ability to engage in life-long learning;
(j) a knowledge of contemporary issues;
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ABET Accreditation

The Engineering Physics curriculum is accredited by the Engineering Accreditation Commission of **ABET** (formerly known as the **A**ccreditation **B**oard for **E**ngineering and **T**echnology). The curriculum includes the basic core of courses in science, mathematics, and engineering common to all engineering curricula: a block of upper division physics courses, and a planned sequence of advance courses in engineering and physics that fulfill the design/synthesis requirement of ABET. The physics and mathematics courses required are very similar to those required for the Professional Physics degree. The result is a very full curriculum, with very little time (within a "standard" four-year time frame) for electives in other academic fields. Of course, all students in the University must satisfy the general education requirements. Details of the curriculum are provided with the course listing for Engineering Physics on the next page. Your faculty advisor must approve all the electives you choose.

The five "engineering electives" (15 hours) taken in the junior and senior years are known as the "Design Sequence" and must be in one of the traditional engineering discipline (e.g., electrical engineering or mechanical engineering). The courses for this Design Sequence must be at the upper-division (3000 or above) level and are set by an engineering advisor in that engineering discipline, subject to the approval of the engineering physics advisor. To meet ABET requirements; the 15-hour Design Sequence must emphasize design. In addition, there are two engineering electives at the 2000 to 4000 level (that are often used to take prerequisites for the Design Sequence), a Physics elective, an Engineering Physics elective (in physics or engineering), and a Technical elective (in math, physics, or engineering). Students often use the engineering physics elective to take an additional engineering course to complement their Design Sequence.

Capstone Project

Engineering Physics students must do a Capstone project (Phys 4300) that emphasizes engineering design. The project can be either in physics or in an engineering discipline, typically the same discipline as the Design Sequence. The mentor for the Capstone project can be a faculty in either engineering or in physics.

Mathematics - Upper Division

For Engineering Physics majors, mathematics is required through Math 3423 - Physical Mathematics II. Students often use their Technical elective to take a math course such as MATH 3333 Linear Algebra, which is very helpful in advanced physics courses However, by using the Technical elective to take a 4000-level math course, Engineering Physics majors can earn a minor in mathematics (Minor code **N670**) by taking a second 4000-level math course.

CURRICULUM GUIDELINES for ENGINEERING PHYSICS DEGREE

Bachelor of Science

Degree Code B372

Semester I (Fall)

PHYS 1205 Phys I for Majors
MATH 1823 Calculus & Analytic Geometry I
or MATH 1914 Differential & Integral Calculus
IENGR 1411 Freshman Engineering Experience
ENGL 1113 Prin. Of English Composition
P SC 1113 American Federal Government

Semester II (Spring)

PHYS 1215 Phys II for Majors
MATH 2423 Calculus & Analytic Geometry II
or MATH 2924 Differential & Integral Calculus II
CHEM 1315 General Chemistry
ENGL 1213 Prin. Of English Composition
or EXPO1213 Expository Writing

Semester III

PHYS 2203 Phys III for Majors: Modern Physics
PHYS 2303 Electronics
MATH 2433 Calculus & Analytic Geometry III
or MATH 2934 Differential & Integral Calculus III
IIC S 1313 Programming for Nonmajors
or C S 1323 Intro. To Computer Programming
HIST 1483 U.S. 1492-1865 or
or 1493 U.S. 1865 - present

Semester IV

PHYS 3043 Physical Mechanics I
MATH 2443 Calculus & Analytic Geometry IV
(not necessary if taken MATH 2934)
MATH 3413 Physical Math I
ENGR 2002 Professional Development
CH E 2313 Structure & Properties of Materials

Semester V

PHYS 3053 Physical Mechanics II
PHYS 3183 Electricity & Magnetism I
MATH 3423 Physical Mathematics II
Engineering elective (2000-4000 level)
Artistic Forms elective

Semester VI

PHYS 3302 Advanced Laboratory I
or PHYS 3312 Advanced Lab II
PHYS 3803 Quantum Mechanics I
AME 3153 Fluid Mechanics
or CEES 2223 Fluid Mechanics
Engineering elective: (Design Sequence 1)
Engineering elective (2000-4000 level)
Social Science elective

Semester VII

PHYS 4153 Statistical Physics Thermodynamics
PHYS 4300 Senior Lab Project (Capstone)
Engineering elective (Design Sequence 2)
Engineering elective (Design Sequence 3)
Technical elective
Non-Western Culture elective

Semester VIII

PHYS 4300 Senior Lab Project (Capstone)
Approved Physics elective
Engineering elective (Design Sequence 4)
Engineering elective (Design Sequence 5)
Engineering Physics elective
Western Civ. & Culture elective

A grade of 'C' or better must be earned in each required course in the curriculum.

Note: If a student has NOT had two years of a foreign language in high school, he or she must take two semesters of a foreign language to satisfy the University's general education requirement.

REQUIREMENTS FOR THE BACHELOR OF SCIENCE IN ENGINEERING PHYSICS

Accredited by the Engineering Accreditation Commission of ABET, **http://www.abet.org**

COLLEGE OF ENGINEERING

THE UNIVERSITY OF OKLAHOMA

For Students Entering the Oklahoma State System for Higher Education **Summer 2014 through Spring 2015**

GENERAL REQUIREMENTS

Total Credit Hours . . . . . **126•**

Minimum Retention/Graduation Grade Point Averages:

Overall - Combined and OU **2.00**

Major - Combined and OU **2.00**

Curriculum - Combined and OU **2.00**

A minimum grade of C is required for each course in the curriculum.

Engineering Physics

B372

Bachelor of Science in Engineering Physics

OU encourages students to complete at least 32 hours of applicable coursework each year to have the opportunity to graduate in four years.

Year	FIRST SEMESTER	Hours	SECOND SEMESTER	Hours
FRESHMAN	**ENGL 1113**, Prin. of English Composition (Core I)	3	**ENGL 1213**, Prin. of English Composition (Core I), **or**	3
	❖**MATH 1914**, Differential and Integral Calculus I (Core I)	4	**EXPO 1213**, Expository Writing (Core I)	
	P SC 1113, American Federal Government (Core III)	3	**CHEM 1315**, General Chemistry (Core II)	5
	§**PHYS 1205**, Intro. Physics I for Physics Majors (Core II)	5	❖**MATH 2924**, Differential and Integral Calculus II (Core I)	4
	ENGR 1411, Freshman Engineering Experience	1	§**PHYS 1215**, Intro. Physics II for Physics Majors	5
	TOTAL CREDIT HOURS	16	TOTAL CREDIT HOURS	17
SOPHOMORE	❖**MATH 2934**, Differential and Integral Calculus III	4	**MATH 3413**, Physical Mathematics I	3
	HIST 1483, U.S., 1492-1865, **or**	3	**CH E 3313**, Structure & Properties of Materials	3
	1493, U.S. 1865-Present (Core IV)		**ENGR 2002**, Professional Development	2
	PHYS 2203, Introductory Physics III: Modern Physics	3	**PHYS 3043**, Physical Mechanics I	3
	PHYS 2303, Electronics	3		
	C S 1313, Programming for Nonmajors, **or**	3	†Approved Elective: Social Science (Core III)	3
	1323, Introduction to Computer Programming			
	TOTAL CREDIT HOURS	16	TOTAL CREDIT HOURS	14
JUNIOR	**MATH 3423**, Physical Mathematics II	3	**PHYS 3302**, Advanced Laboratory I **or**,	2
	PHYS 3053, Physical Mechanics II	3	**3312**, Advanced Laboratory II	
	PHYS 3183, Electricity & Magnetism	3	**PHYS 3803**, Introduction to Quantum Mechanics I	3
			AME 3153, Fluid Mechanics, **or**	3
	Engineering Elective (2000-4000-level)	3	**CEES 2223**, Fluid Mechanics	
	†Approved Elective: Artistic Forms (Core IV)	3	Engineering Elective (2000-4000-level)	3
			✦Engineering Elective (Design Sequence 1)	3
	TOTAL CREDIT HOURS	15	TOTAL CREDIT HOURS	14
SENIOR	**PHYS 4153**, Statistical Physics & Thermodynamics	3	**PHYS 4300**, Senior Lab Project (Capstone)	2
	PHYS 4300, Senior Lab Project (Capstone)	2		
			Approved Physics Elective	3
	✦Engineering Elective (Design Sequence 2)	3	✦Engineering Elective (Design Sequence 4)	3
	✦Engineering Elective (Design Sequence 3)	3	✦Engineering Elective (Design Sequence 5)	3
	‡Technical Elective	3	♦Engineering Physics Elective	3
	†Approved Elective: Non-Western Culture (Core IV)	3		
			†Approved Elective: Western Civ. & Culture (Core IV)	3
	TOTAL CREDIT HOURS	17	TOTAL CREDIT HOURS	17

NOTE: Engineering transfer students may take ENGR 3511 in place of ENGR 1411.

Courses designated as Core I, II, III, IV, or Capstone are part of the General Education curriculum. Students must complete a minimum of 40 hours of General Education courses, chosen from the approved list.

†To be chosen from the **University-Wide General Education Approved Course List.** Three of these 12 hours must be upper-division (3000-4000). See list in the Class Schedule.

In the College of Engineering, in order to progress in your curriculum, and as a specific graduation requirement, a grade of C or better is required in each course in the curriculum. Please refer to the General Catalog for additional enrollment limitations.

Students must successfully complete prerequisite courses (with a minimum C grade) before proceeding to the next course.

• Two college-level courses in a single foreign language are required; this may be satisfied by successful completion of 2 years in a single foreign language in high school. Students who must take foreign language at the University will have an additional 6-10 hours of coursework.

§With approval of adviser, PHYS 2514, 2524, and PHYS 1311 and 1321 may substitute for PHYS 1205, 1215.

‡A course numbered 3000 or above from engineering, physics or mathematics. Co-op students may substitute 3 hours of ENGR 2281, on approval of adviser. A 2000-level engineering course may be used if prerequisite for engineering design sequence. Must be approved by adviser.

✦The 15 hours of engineering electives in an engineering discipline must emphasize engineering design. Electives must be approved by adviser.

♦A course numbered 3000 or above from engineering or physics. A 2000-level engineering course may be used if it is a prerequisite of a design sequence and the technical elective is not a 2000-level course. **Electives must be approved by Adviser.**

❖MATH 1823, 2423, 2433, and 2443 sequence can be substituted for MATH 1914, 2924, and 2934.

3-14

COURSES IN AEROSPACE AND MECHANICAL ENGINEERING (AME)

3153 Fluid Mechanics. Prerequisite: 2113, 2213, or Engineering 2113, 2213, Mathematics 3113. Principles of fluid mechanics: fluid statics, flow descriptions, conservation equations, dimensional analysis, potential flow, viscous flow and internal flow. (F)

COURSES IN CHEMICAL ENGINEERING (CH E)

3313 Structure and Properties of Materials. Prerequisite: CHEM 1415 or CHEM 1425, PHYS 2524 or PHYS 1215, and CHE 3473. The behavior of materials under various conditions and environments is correlated to atomic and molecular structure and bonding. (Sp)

COURSES IN CHEMISTRY AND BIOCHEMISTRY (CHEM)

1315 General Chemistry. Prerequisite: Mathematics 1503 or 1643, or math ACT equal to or greater than 23. First of a two-semester sequence in general chemistry. Topics covered: basic measurement, gas laws and changes in state, stoichiometry, atomic theory, electron configuration, periodicity, bonding, molecular structure and thermochemistry. Laboratory (F, Sp, Su) [II-LAB]

COURSES IN CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE (CEES)

2223 Fluid Mechanics. Prerequisites: 2113 or AME 2113 or P E 2113, and Mathematics 3113 or concurrent enrollment. Coverage of the fundamentals of fluid statics and dynamics. Formulation of the equation of fluid flow, i.e., Navier-Stokes equation, Eulers equations, Bernoulli equations, etc. and their application. Examples of ideal fluid flow, such as flow in open and closed conduits. (Sp)

COURSES IN COMPUTER SCIENCE (C S)

1313 Programming for Nonmajors. Prerequisite: MATH 1523 or concurrent enrollment. Introduction to the design and implementation of computer programs. Emphasis on problem solving. (F, Sp)

1323 Introduction to Computer Programming. Prerequisite: MATH 1523 or concurrent enrollment, or placement into MATH 1743 or MATH 1823 or higher. Introduction to the design and implementation of computer software with an emphasis on abstraction and program organization. (F, Sp)

COURSES IN ENGINEERING (ENGR)

1411 Freshman Engineering Experience. Prerequisite: declared major in Engineering or permission of instructor. Required of all entering freshmen with a declared Engineering major. Lecture hours cover a variety of topics including: majors and minors; career planning; advising; and extra-curricular activities. Students also work on multi-disciplinary engineering projects in smaller groups during the lab hour. (F)

2002 Professional Development. Prerequisite: sophomore standing. Develop an understanding of engineering ethics, teamwork, leadership, and professional responsibility through the concepts of contemporary, social, and global issues. (F, Sp)

COURSES IN MATHEMATICS (MATH)

1914 Differential and Integral Calculus I. Prerequisite: satisfactory score on the placement test or, for incoming freshmen direct from high school, satisfactory score on the ACT/SAT. Duplicates three hours of 1823 and one hour of 2423. Limits and continuity, differentiation, applications of differentiation to optimization and curve sketching, integration, the fundamental theorem of calculus, the substitution rule, applications of integration to computation of areas. (F, Sp, Su) [I-M]

2924 Differential and Integral Calculus II. Prerequisite: 1914 with a grade of C or better. Duplicates two hours of 2423 and two hours of 2433. Further applications of integration, the natural logarithmic and exponential functions, indeterminate forms, techniques of integration, improper integrals, parametric curves and polar coordinates, infinite sequences and series. (F,Sp, Su)

2934 Differential and Integral Calculus III. Prerequisite: 2924 with a grade of C or better. Duplicates one hour of 2433 and three hours of 2443. Vectors and vector functions, functions of several variables, partial differentiation and gradients, multiple integration, line and surface integrals, Green-Stokes-Gauss theorems. (F, Sp, Su)

†G3413 Physical Mathematics I. Prerequisite: MATH 2443 or MATH 2934 or concurrent enrollment. Complex numbers and functions. Fourier series, solution methods for ordinary differential equations and partial differential equations, Laplace transforms, series solutions, Legendre's equation. Duplicates two hours of 3113. (F)

†G3423 Physical Mathematics II. Prerequisite: 2443, 3413. The Fourier transform and applications, a survey of complex variable theory, linear and nonlinear coordinate transformations, tensors, elements of the calculus of variations. (F, Sp)

COURSES IN PHYSICS (PHYS)

1205 Introductory Physics I for Physics Majors. Prerequisite: enrollment in Mathematics 1823 or 1914 or permission of instructor. To be taken by physics, astronomy and engineering physics majors during the first semester of their freshman year. Kinematics, dynamics, work and energy, many-particle systems, rigid body rotation, simple harmonic motion. Laboratory is an integral part of the course. Laboratory (F) [II-LAB]

1215 Introductory Physics II for Physics Majors. Prerequisite: 1205 or permission of instructor. Electricity and magnetism: static fields and forces, circuits, electromagnetic induction. Thermodynamics: the First and Second Laws, temperature, heat, work and entropy. Laboratory is an integral part of the course. Laboratory (Sp)

2203 Introductory Physics III: Modern Physics. Prerequisite: 1215 or 2524 (or concurrent enrollment), or permission of instructor. An introduction to and overview of key concepts in contemporary physics, with emphasis on the contrast between classical and modern ways of thinking about the physical universe. Includes an introduction to selected major subject areas, which might include light and optics, relativity, atoms and molecules, the solid state, nuclei, elementary particles, fundamental interactions, cosmology and/or chaos. Students will also explore selected topics in current physics research. (F)

2303 Electronics. Prerequisite: 1215 or 2524 (or concurrent enrollment), or permission of instructor. An introduction to the characteristics of semiconductor electronic components and their use in the design and operation of practical analog and digital electronic circuits. The emphasis will be on gaining a working knowledge of basic circuits and preparation for understanding and building electronic circuits encountered by experimental research physicists. (F)

3043 Physical Mechanics I. Prerequisite: 1205 or 2514, and Mathematics 3113 or 3413 (or concurrent enrollment); or permission of instructor. Differential equations based continuum mechanics: Newtonian particle mechanics, driven and damped oscillations, vibrations and waves, and their application to other linear systems, non-linear oscillations, introduction to Lagrange's equations. (Sp)

†G3053 Physical Mechanics II. Prerequisite: 3043 or permission of instructor. Lagrangian and Hamiltonian dynamics. Non-inertial reference frames. Rigid body motion. Central forces and collisions. Special relativity. (F)

†G3183 Electricity and Magnetism I. Prerequisite: 2203, Mathematics 3413 or concurrent enrollment; or permission of instructor. Electrostatics, dielectrics, continuity conditions, magnetic forces and fields, magnetic induction, magnetization, Maxwell's equations. (F)

3302 Advanced Lab I. Prerequisite: 2303 or permission of instructor. Junior-level experiments in physics. (F, Sp)

3312 Advanced Lab II. Prerequisite: 3302 or permission of instructor. Junior-level experiments in physics. (F, Sp)

†G3803 Introduction to Quantum Mechanics I. Prerequisite: 2203 or permission of instructor. Fundamental ideas of quantum physics. Postulates of quantum theory, wave functions, operators, the Schrödinger equation, one-dimensional systems. Mathematical tools of quantum mechanics. Theory of measurement. Stationary and nonstationary states. (Sp)

G4153 Statistical Physics and Thermodynamics. Prerequisite: 3803. Statistical properties of physical systems. Entropy and temperature, the Boltzmann distribution, Fermi-Dirac and Bose-Einstein gases. Thermodynamic functions. Statistical interpretation of thermodynamics. (F)

4300 Senior Research Project. 1 to 3 hours. Prerequisite: senior standing in major and permission of instructor. May be repeated once. Research project, experimental or theoretical, to be arranged with individual faculty, leading to a senior thesis. Group seminars to discuss projects and other topics of current interest in physics and astronomy. Total of four hours required for general education capstone. (F, Sp) [V]

IF YOU CHOOSE A PHYSICS, ASTROPHYSICS OR ENGINEERING PHYSICS HONORS COLLEGE PROGRAM

The Honors College at the University of Oklahoma is dedicated to providing academically gifted students with the opportunity to develop their intellectual potential to the fullest. By maintaining a high GPA and participating in honors-designated courses/sections, as well as special seminars and workshops, students can earn degree designations of *cum laude*, *magna cum laude*, or *summa cum laude*.

Honors-designated general education courses within the department include Phys 1205 and 1215 – Physics for Majors, and Phys 2514 and 2524 – General Physics for Engineers. Upper division courses include Phys 3960 – Individual Honors Reading, and Phys 3980 – Individual Honors Research.

Full details about the Honors College and honors curriculum may be obtained from the Honors College office, David L. Boren Hall at Lindsey and Asp. For specific questions about graduating with Honors in physics, astrophysics and engineering physics, including the capstone requirements for Honors, talk to the department's Honors College faculty advisor, Dr. Michael Strauss.

IF YOU CHOOSE A PHYSICS OR ASTRONOMY MINOR

You can earn a "minor" in Physics (Minor Code **N780**) or Astronomy (Minor Code **N080**) from the College of Arts and Sciences by completing the course requirements (21-28 credit hours) given in the curriculum guidelines in this section. Go to The College of Arts and Sciences' Hobson Academic Advising Center in 124 Ellison Hall to fill out a "Request for Area of Concentration, Minor, or Second Major" to officially declare your minor. A minor can be a valuable adjunct to such majors as mathematics, meteorology, philosophy, or literature.

Sample curriculum guidelines and worksheets for each of these minors are detailed on the following pages.

NOTES on MINORS:

1) The total number of hours needed to complete a minor in Astronomy or Physics may be higher than the Minimum Required Hours listed, as that number does not include the 12 credit hour calculus sequence, that are prerequisites for required courses in the minor.

2) Astronomy, astrophysics, majors can NOT earn a double major or a minor in physics nor vice versa. Engineering Physics majors cannot earn a major or minor in physics.

*3) Physics, astrophysics, and engineering physics majors are required to take the required 12 hours of calculus, as well as MATH 3413 and MATH 3423. These majors can earn a minor in mathematics (Minor Code **N670**) by taking two additional 4000-level math courses.*

4) The College of Engineering offers minors in Computer Science and in Electrical and Computer Engineering. Students interested in these minor should visit the William Student Services Center, 112 Felgar Hall for details.

PHYSICS MINOR – Sample Curriculum

PHYSICS 1205 SAMPLE CURRICULUM

Semester I (Fall)		Semester II (Spring)	
PHYS 1205	Physics I for Physics Majors	PHYS 1215	Physics II for Phys Majors *or*
MATH 1823	Calculus & Analytic Geometry I	MATH 2423	Calc & Analytic Geometry II
or MATH 1914	Differential & Integral Calculus I	*or* MATH 2924	Differential & Integral Calculus II
Semester III		**Semester IV**	
PHYS.2203	Phys III for Majors: Modern Physics	PHYS 3043	Physical Mechanics I
MATH 2433	Calculus & Analytic Geometry III	MATH 3413	Physical Math I
or MATH 2934	Differential & Integral Calculus III	*MATH 2443	Calculus & Analytic Geometry IV (Not necessary if taken MATH 2934)
Semester V		**Semester VI**	
(PHYS 3053)	Physical Mechanics II	(PHYS 3803)	Intro to Quantum Mech I
(PHYS 3183)	Electricity & Magnetism I		

Math 2443 (or equivalent) is a prerequisite or concurrent enrollment for MATH 3413
( ) Indicates the course is optional; however, at least ONE of the courses listed is required.

PHYSICS 2514 SAMPLE CURRICULUM

Semester I (Fall)		Semester II (Spring)	
MATH 2423	Calculus & Analytic Geometry II	[PHYS 1321]	General Physics Lab II
or MATH 2924	Differential & Integral Calculus II	PHYS 2524	General Physics for Engrs
[PHYS 1311]	General Physics Lab I	MATH 2433	Calc & Analytic Geometry III
PHYS 2514	General Physics for Engineers	*or* MATH 2934	Differential & Integral Calculus III
Semester III		**Semester IV**	
PHYS 2203	Intro Phys III: Modern Physics	PHYS.3043	Physical Mechanics I
[PHYS 2303]	Electronics	MATH 3413	Physical Math I
*MATH 2443	Cal & Analytic Geometry IV (Not necessary if taken MATH 2934)		
Semester V		**Semester VI**	
(PHYS 3053)	Physical Mechanics II	(PHYS 3803)	Intro to Quantum Mech I
(PHYS 3183)	Electricity & Magnetism I		
[PHYS 3302]	Junior Lab I		

*Math 2443 (or equivalent) is a prerequisite (or concurrent enrollment) for MATH 3413
( ) Indicates the course is optional; however, at least ONE of the courses listed is required.
[ ] Indicates the course is optional; however, 2 credit hours of lab is required.

Minimum Required Hours:		
	Physics	19
	Mathematics	3
		21

NOTE: The total number of hours needed to complete the minor may be higher than the Minimum Required Hours listed above, as that number does not include the Math 1823, 2423, 2433, 2443 calculus sequence, which are prerequisites for required courses in the minor.

THE UNIVERSITY OF OKLAHOMA
COLLEGE OF ARTS & SCIENCES

Requirements for a minor in

Physics – N780

GENERAL REQUIREMENTS

At least six (6) credit hours must be earned in courses acceptable for residence credit by standards set forth by the College of Arts and Sciences, *excluding* transfer, correspondence, and examination (AP, CLEP, Advanced Standing) credit. Courses for the minor may not be taken Pass/No Pass.

SPECIFIC REQUIREMENTS

Students must successfully complete at least 19 hours of courses acceptable for major credit in Physics, including at least nine (9) hours at the upper-division level. The following specific requirements must be met:

1. PHYS 1205 *
2. PHYS 1215 *
3. PHYS 2203
4. PHYS 3043
5. PHYS 3053 **or** 3183 **or** 3803
6. MATH 3413

	Dept. abbreviation	Course #	Credit Hours	Grade
1.	PHYS	1205*	5	
2.	PHYS	1215*	5	
3.	PHYS	2203	3	
4.	PHYS	3043	3	
5.	PHYS		3	
6.	MATH	3413	3	

* PHYS 1205 and 1215 may be replaced by PHYS 2514 and 2524, plus PHYS 1311 and 1321 or 2303 or 3302.

No single course may be used by a student to satisfy a major requirement and a minor requirement. A course may be used, however, to satisfy both a major support requirement and a minor requirement. Requests to substitute a minor requirement must be approved in writing by the Department of Physics & Astronomy.

The requirements for a minor must be completed concurrently with the major degree requirements. No minor may be added by completing courses after receiving the bachelor's degree. Minors in the College are available to all undergraduate students at OU. If the minor is officially declared, successfully completed, and noted on the graduation application, the student's transcript will so indicate at the time the bachelor's degree is posted.

Approved March 2013

ASTRONOMY MINOR – Sample Curriculum

PHYSICS 1205 SAMPLE CURRICULUM

Semester I	(Fall)	Semester II	(Spring)
PHYS 1205	Physics I for Physics Majors	PHYS 1215	Phys II for Physics Majors
*MATH 1823	Calculus & Analytic Geometry I	*MATH 2423	Calculus & Analytic Geometry II
or *MATH 1914	Differential & Integral Calculus I	*or* *MATH 2924	Differential & Integral Calculus II
Semester III		**Semester IV**	
PHYS 2203	Phys III for Majors: Modern Physics	PHYS 3043	Physical Mechanics II
MATH 2433	Calculus & Analytic Geometry III	MATH 2443	Calculus & Analytic Geometry IV
or MATH 2934	Differential & Integral Calculus III		(not necessary if taken MATH 2934)
ASTR 2513	Introductory Astrophysics/ Observatory Methods	†MATH 3413	Physical Mathematics I
		or †MATH 3113	Ordinary Differential Equations
Semester V		**Semester VI**	
ASTR 3103	Stars	ASTR 3113	Galaxies & Cosmology

*Courses are either a prerequisite for, or a required concurrent enrollment for a required course
†PHYS 3043 has a prerequisite (or concurrent enrollment) of either Math 3413 OR MATH 3113

Required Hours:		
	Physics	16
	Astronomy	9
	Mathematics	3
		28

PHYSICS 2514 SAMPLE CURRICULUM

Semester I	(Fall)	Semester II	(Spring)
PHYS 2514	General Physics for Engrs	PHYS 2524	General Physics for Engrs
*MATH 2423	Calc & Analytic Geometry II	*MATH 2433	Calculus & Analytic Geometry III
or *MATH 2924	Differential & Integral Calculus II	*or* *MATH 2934	Differential & Integral Calculus III
Semester III		**Semester IV**	
PHYS.2203	Phys III for Majors: Modern Physics	PHYS 3043	Physical Mechanics I
ASTR 2513	Introductory Astrophysics/ Observatory Methods	†MATH 3413	Physical Mathematics I
		or †MATH 3113	Ordinary Differential Equations
MATH 2443	Calculus & Analytic Geometry IV (Not necessary if taken MATH 2934)		
Semester V		**Semester VI**	
ASTR 3103	Stars	ASTR 3113	Galaxies & Cosmology

*Courses are prerequisites for a required course
†PHYS 3043 has a prerequisite (or concurrent enrollment) of either Math 3413 OR MATH 3113

Minimum Required Hours:		
	Physics	14
	Astronomy	9
	Mathematics	3
		26

NOTE: The total number of hours needed to complete the minor may be higher than the Minimum Required Hours listed above, as that number does not include Math 1823, 2423, 2433, and Math 3113 or Math 3413, which are prerequisites for required courses in the minor.

THE UNIVERSITY OF OKLAHOMA
COLLEGE OF ARTS & SCIENCES

Requirements for a minor in

Astronomy – N080

GENERAL REQUIREMENTS

At least six (6) credit hours must be earned in courses acceptable for residence credit by standards set forth by the College of Arts and Sciences, *excluding* transfer, correspondence, and examination (AP, CLEP, Advanced Standing) credit. Courses for the minor may not be taken Pass/No Pass.

SPECIFIC REQUIREMENTS

Students must successfully complete at least 26 hours of courses acceptable for major credit in Astronomy, including at least nine (9) hours at the upper-division level. The following specific requirements must be met:

1. PHYS 1205 **or** PHYS 2514
2. PHYS 1215 **or** PHYS 2524
3. PHYS 2203
4. PHYS 3043
5. ASTR 3103
6. ASTR 3113
7. ASTR 2513
8. MATH 2443

	Dept. abbreviation	Course #	Credit Hours	Grade
1.	PHYS	1205 or 2514		
2.	PHYS	1215 or 2524		
3.	PHYS	2203	3	
4.	PHYS	3043	3	
5.	ASTR	3103	3	
6.	ASTR	3113	3	
7.	ASTR	2513	3	
8.	MATH	2443	3	

No single course may be used by a student to satisfy a major requirement and a minor requirement. A course may be used, however, to satisfy both a major support requirement and a minor requirement. Requests to substitute a minor requirement must be approved in writing by the Department of Physics & Astronomy.

The requirements for a minor must be completed concurrently with the major degree requirements. No minor may be added by completing courses after receiving the bachelor's degree. Minors in the College are available to all undergraduate students at OU. If the minor is officially declared, successfully completed, and noted on the graduation application, the student's transcript will so indicate at the time the bachelor's degree is posted.

Approved May 2005

AIMING HIGHER – GRADUATE DEGREES

Graduate students are vital to the success of a university. They not only assist with teaching and research, but they insure the "give and take" of the learning process with new ideas and new approaches to old problems. Friendships and collaborations formed in graduate school between students and professors last a lifetime.

If you want a degree beyond the bachelor level, certain preparations are needed now – during your undergraduate years. Graduate program admissions often require GRE scores, certain GPA levels on transcripts with a posted bachelor degree, a statement of purpose, 3 or more letters of recommendation, and TOEFL scores if English is not your native language. Since each graduate program may have its own special requirements, be sure to read the application materials carefully and ask questions.

GRE Scores

Most, if not all, graduate schools in the United States require students to submit scores from standardized Graduate Record Examinations (GRE), usually taken during the student's junior or senior year. We strongly recommend that you take the Subject Test in your junior year. Administered by Educational Testing Service (ETS), Princeton, NJ, the GRE consists of a general exam and a subject exam. The General Test measures verbal, quantitative, and analytical reasoning skills that have been developed over a long period and are not necessarily related to any particular field of study. The Subject Test measures achievement in a particular subject area and assumes an extensive background in the test discipline (physics is just one of 16 Subject Tests). ETS has testing schedules that include computer-based testing (CBT) along with the traditional paper-based testing. CBT is available for the general exam only and can be taken any time during the year. Paper-based testing for the subject exam (and general) is only offered for limited times each year stateside and requires a two-month advance registration. It is important for students wanting to enter graduate school to take these exams. You can visit GRE Online at **http://www.gre.org** to learn more about test dates and locations, sample test preparation materials, and costs associated with each exam.

When enough interest is shown, Professor Eric Abraham holds a series of study sessions for students planning to take the GRE. If you are interested in participating, contact Dr. Abraham for details.

Grade Point Average (GPA)

Usually, a cumulative grade point average of 3.00 on a 4.00 scale is required for full admission. Sometimes a lower GPA (2.75+) is considered if other factors indicate a good chance for success. You cannot be admitted to a graduate program if you do not have an undergraduate degree. Applications are usually reviewed with the understanding that a degree will be posted to an official transcript within a month or two of your graduation.

Statement of Purpose

Admission committees often want to know what a student's goals and objectives are when applying to graduate school. What do you hope to gain? Where do you want to be in 5 years? 10 years? What areas of research do you think you might be interested in? These are just some of the questions you may want to address in your statement.

Letters of Recommendation

Three letters from professors who know you and your abilities are usually needed. These are very important and are often the deciding factor on who gets into a program and how much financial support they may be offered. Now is the time to get to know your professors. Speak up in class. Participate in projects. Inquire about research opportunities. Make yourself known in a positive way.

TOEFL

Students whose native language is not English must often prove their abilities in writing and speaking English in order to get into a graduate program. Depending on the school, score requirements vary. Testing can sometimes be waived if a student takes a two-semester course in English as an undergraduate in an English speaking college or university and receives grades of "B" or better.

Financial Assistance

Graduate programs throughout the United States and the world actively recruit new graduate students. Teaching assistantships and research assistantships are awarded to many students to help finance their graduate studies. Stipends, fellowships, incentive recruitment funds, prospective student visits, etc., are just some of the financial inducements you may receive to select one program over another. Within our department, we currently offer first-year graduate students stipends of about $1,600 per month. In addition, we provide full out-of-state tuition waivers, partial in-state fee waivers and health care coverage. Other schools provide many of these same benefits – some more, some less.

Information Sources

Posters about physics, astronomy and engineering physics graduate opportunities are posted for 30+ days on the bulletin boards in Nielsen Hall and then filed in an accessible cabinet located in the Student Study Lounge, room 301. Browse through the posters and booklets at your leisure. You will be surprised by the number of programs and variety of research areas available to interested students. Other good sources include the American Institute of Physics' *Graduate Programs in Physics, Astronomy, and Related Fields*, and *Peterson's Guides to Graduate Study - Book 4* and *Book 5*. These guides may be found in the reference section of the university's main library.

DEPARTMENTAL SERVICES

Library

As you advance through the Physics curriculum, it is important that you begin to take responsibility for your own education, and learn to think for yourself. Learn to use the Physics and Astronomy section of the main library to find and read supplemental texts relevant to your coursework. Look through current periodicals to stimulate your awareness of what is taking place in the scientific community. Perhaps you will find some particular author who "speaks to you" – whose writings you can use to fill out your knowledge, to introduce you to some modern topics, or to help you understand ideas discussed in class. The student who learns to do this early is well on the way to becoming a good physicist.

Computer Lab

The department has a computer laboratory Nielsen Hall. This lab consists of personal computers networked together and connected to printers. This facility is open to students for both general use and for class assignments. There are some times when the laboratory is reserved for meetings of classes and is not available for general use. These reserved times are posted on the door each week. The software available in the lab includes word processors, mathematical and graphics software packages, simulation programs, and programming languages. These are the sorts of computational resources that are generally available to scientists today.

Tutoring

The department offers free tutoring for all students enrolled in undergraduate introductory physics and astronomy courses (Astr 1504, Phys 1114, Phys 1205-1215, Phys 2414-2424, and Phys 2514-2524). An experienced graduate student tutor is available during the fall and spring semesters. The current tutoring schedule is available in the Physics Office, 100 Nielsen Hall.

Student Study Lounge

Room 303 Nielsen Hall is designated as the Student Study Lounge area during the fall and spring semesters. Occasionally, departmental talks and meetings are scheduled in this room, but primarily it is open and available to all students for study purposes during building hours (Monday through Friday, 7:00 a.m. – 10:00 p.m.).

JOB AND SCHOLARSHIP OPPORTUNITIES FOR UNDERGRADUATES

Departmental Opportunities

Faculty members with research grants often hire undergraduates to help with their research, generally during the summer. These positions are usually awarded on a first-come first-serve basis to good students. Undergraduates are also hired throughout the year to assist in the computer lab. Talk with your instructors and departmental advisors about opportunities.

Our department has operated a NSF Research Experience for Undergraduates (REU) site since 1996. In an REU, selected undergraduates from across the nation and OU work together with faculty in various areas of experimental and theoretical research. A stipend with partial room and board is offered during the nine-week program. All physics, astronomy, astrophysics, and engineering physics majors are eligible to apply.

Off Campus Opportunities

Many colleges and universities around the country offer exciting summer internship programs and workshops. These opportunities are primarily for juniors and seniors but occasionally beginning students are invited to apply. As flyers arrive, they are posted on the bulletin board. Application materials often on filed in the Physics Office (100 Nielsen Hall) and are available for viewing whenever the office is open. Office staff will copy any information you need to apply to the various programs. Application deadlines for these programs are usually early – January and February – so do not procrastinate if you are interested in summer research. Start checking in the office in December for the upcoming summer.

Departmental Scholarships

The *J. Clarence Karcher Scholarship*s are funded through an endowment given to the Homer L. Dodge Department of Physics and Astronomy by the late Dr. J. Clarence Karcher, a 1916 graduate of the Department of Physics and the inventor of reflection seismography. These scholarships are awarded annually on the basis of academic merit as evidenced by grades and achievement test scores. To be eligible for the scholarship, a student must be a declared major in one of our programs and must maintain a high level of academic performance. The award is currently $1400 for an academic year ($700 if the student has a general university-administered academic scholarship in the amount of $1,000 or more). *Karcher Scholars* may apply for the renewed of the scholarship through the 4th year of study in their major for a maximum of 8 semesters if a high level of academic performance is maintained. The application form for the *J. Clarence Karcher Scholarship* is available in the Department Office at the beginning of the spring semester. It may also be downloaded from the departmental website at: **http://www.nhn.ou.edu/karcher.shtml**

The *Cuba and Ted Webb Scholarship*, established in 1997, is funded through a generous gift from Cuba and Ted (BS Physics, 1951) Webb. This $1,600 scholarship is presented annually on the basis of merit and need to an outstanding upper-division undergraduate student majoring in astronomy, astrophysics, physics or engineering physics.

The *Homer L. Dodge Scholarship* is funded by donations from the faculty in the Homer L. Dodge Department of Physics and Astronomy. It is anticipated that the Dodge Scholarship (currently $1,600 per year) will be offered annually on the basis of merit and need to an outstanding student who has completed at least one year of study their major of astronomy, astrophysics, physics, or engineering physics.

The *Roy B. Adams Engineering Physics Scholarship* was first awarded in May 1999. This annual scholarship (typically $2,000) is available to Engineering Physics majors with at least 30 semester hours and a cumulative GPA of 3.00 or better.

An application form for the *Cuba and Ted Webb*, *Homer L. Dodge*, and the *Roy B. Adams Engineering Physics* scholarships is available in the Department Office at the beginning of each spring semester.

General Scholarships

General Scholarships are awarded through the Financial Aids Office of the University of Oklahoma. For a complete, up to date listing of all scholarships and specific requirements for each, contact the Financial Aids Office for a copy of their current booklet entitled, *A Guide to Financial Aid and Scholarships at the University of Oklahoma*. Financial aid information from the university is available at: **http://financialaid.ou.edu/scholarships/**

Departmental Awards

Each spring, students in all our degree programs, who exhibit Meritorious Scholarship and/or receive a departmental scholarship, are recognized at an annual Awards Day. At this ceremony, *The Fowler Prize* (established in memory of the late Richard G. Fowler, Professor Emeritus, Homer L. Dodge Department of Physics and Astronomy) is presented annually to the Outstanding Graduating Senior in the Department. *The Fowler Prize* carries with it a plaque and a monetary award. The Outstanding Sophomore and Junior in the Homer L. Dodge Department of Physics and Astronomy are each recognized with *The Dodge Prize,* which also carries with it a plaque and a monetary award. Likewise, the *William Schriever Awards*, *Duane E. Roller Awards*, and *J. C. Karcher Awards* are presented annually to outstanding sophomores, juniors, and seniors in Physics/Astrophysics and in Engineering Physics.

EXTRA-CURRICULAR ACTIVITIES

Society of Physics Students (SPS)

SPS is a national student organization for physics, engineering physics, astrophysics and astronomy majors, both graduate and undergraduate, as well as anyone else interested in physics. Besides regularly scheduled meetings, activities include pizza parties, talks by professors, an annual spring picnic, out-of-state conference opportunities, etc. SPS provides an informal setting for meeting other students with similar interests. For the freshman and sophomore, upper-classmen can give help, insight and guidance into lower level courses. For juniors and seniors, SPS provides graduate school and job-related information.

For meeting and activity dates, go to the SPS website: **http://www.ou.edu/student/spsweb/** or leave a message in the SPS mailbox in the Department Office, 100 Nielsen Hall. The SPS faculty sponsor is Dr. Matthew Johnson, Professor of Physics and Astronomy.

Students for the Exploration and Development of Space (SEDS)

This campus organization is a chapter of the national SEDS organization. SEDS is dedicated to informing and promoting all aspects of space exploration – including astronomy, space travel, and exploitation of space resources. Students from all majors with an interest in space are welcome to join. The SEDS faculty sponsor is Dr. Susan Postawko, Associate Professor of Meteorology. Details can be found at: **http://www.ou.edu/seds/**

Alpha Sigma Kappa (ΑΣΚ)

Alpha Sigma Kappa is a professional organization for women in technical studies. A schedule of current activities as well as membership requirements may be obtained from the group's advisor, Dr. Amy McGovern, Assistant Professor of Computer Science.

APS Membership

The American Physical Society offers a free one-year trial membership in APS to undergraduate and graduate students enrolled in physics or a related degree program. This free trial is for full time students who have never been an APS member nor received the offer previously. Membership benefits include a free subscription to *Physics Today*, monthly magazine containing news of physics and articles of interest to the physics community. Details can be found at: **http://www.aps.org/membership/student.cfm**

Colloquia

Most Thursday afternoons at 4:00 p.m. - fall and spring semesters - the department hosts a colloquium (an academic seminar on a broad field of study led by a guest lecturer). A different

speaker is invited each week to present their particular area of research or study. Although many of the discussions may be too technical for beginning undergraduates to understand, these informal talks provide an opportunity for students to meet local, national and international scientists and hear many different viewpoints. Everyone is invited to attend.

Departmental Tea

During the fall and spring semesters, the department holds a daily "tea" from 3:30 to 4:00 p.m. Cookies, lemonade, coffee and tea are served each day in the first floor foyer of Nielsen Hall. To help defray expenses, a semester fee is collected from those who wish to attend every day, or a daily fee is collected from those who attend occasionally. Tea is open to everyone and provides an informal, relaxed setting for faculty, staff and students to visit with one another and exchange views.

Fall Picnic

Annually, the department enjoys a friendly, relaxed family picnic. This potluck affair brings together faculty, staff, graduate students, undergraduate students, and their family and friends for good food and good conversation. In addition, the afternoon offers a good game of volleyball for those who want to participate. Picnic detailed are posted in Nielsen Hall and sign-up sheets can be found in the Physics office.

CAREERS

What do Physicists, Astronomers, and Engineering Physicists do?

Physics offers challenging, exciting, and productive careers. As a career, physics covers many specialized fields – from acoustics, astronomy, and astrophysics to medical physics, geophysics, and vacuum sciences (see Overview of Some Fields of Physics on the next two pages). Physics offers a variety of work activities – lab supervisor, researcher, technician, teacher, and manager. A person trained in physics acquires a set of skills that makes him or her a valued employee in many settings. Physics opens doors to employment opportunities throughout the world in government, industry, schools, and private organizations. Students, who elect not to pursue a research or teaching position, will find physics is an asset recognized by medical schools, law schools, and business schools. High-school teachers with a bachelor's degree in astronomy, physics, or engineering physics are likely to be in especially strong demand in the future. For many research or university positions, a PhD degree is required. As might be expected, the starting salaries for physicists are higher at the higher degree levels, and at each degree level, a physicist commands a higher salary than the average of his or her peers in other fields.

Astronomy faculty at universities and researchers at observatories usually have a graduate degree, typically a Ph.D. However, many students who earn a B.S. in Astronomy work as staff at astronomical observatories, planetaria, etc. However, the curriculum in astronomy or astrophysics that you will study at the University of Oklahoma is very rich in physics and math. Thus astronomy and astrophysics graduates, who elect not to pursue a graduate degree, often work as a physicist in industry or in a government laboratory. More information about careers in astronomy can be found at: http://aas.org/career .

Engineering physics graduates are often employed in industry or in government labs as either engineers or physicists. With their unique blend of pure and applied science, engineering physics graduates are frequently working at the cutting edge of science and technology. As Engineering Physics is a truly interdisciplinary program that few universities offer, many engineering physics graduates working in industry are initially employed in the engineering discipline of their design sequence and therefore have a corresponding job title. Thus with a design sequence in electrical engineering, the engineering physicist may be called an Electrical Engineer. Many Engineering Physics graduates also go to graduate school in either physics or an engineering discipline.

Past BS degree graduates of the Homer L. Dodge Department of Physics and Astronomy have entered the job market in positions with government agencies of nonprofit organizations such as: NASA, NIST, the Department of Defense, the Oklahoma Department of Environmental Quality, the Smithsonian Institution, and Teach for America. Some major companies that regularly hire BS and MS degree physics, engineering physics, and astronomy students are: Agilent, Bell Helicopter, Boeing, Data Ray, General Electric, Halliburton, Honeywell, Microsoft Corp., Microtune, Raytheon, Schlumberger, SouthWest Nanotechnology, SunPower, Texas Instruments, etc. A complete list of

companies that recruit our graduates is available in the University's Career Services office located in the Oklahoma Memorial Union.

Through the years, our graduates have included one president of a state university, a U.S. ambassador, the director of the National Science Foundation, five founders of corporations, a famous Arctic explorer, the founder and first editor of *The American Journal of Physics*, three other journal editors, three inventors, eight research lab managers, eight departmental chairpersons, a Rhodes Scholar, two Guggenheim Fellows, 80 university professors, and more than 500 other people devoted to advancing knowledge and improving the quality of life.

OVERVIEW OF SOME FIELDS OF PHYSICS

Acoustics - the study of sound. An acoustical physicist could be involved in the design of a concert hall, stereos, or synthesizers.

Astrophysics - the extension of basic physics into the cosmos. Astrophysicists study the life cycles of stars and the processes that gave rise to our expanding universe at the moment of the "big bang."

Atomic physics - the study of atoms and their dynamical properties. The use of lasers, molecular beams, and high precision detectors has made new discoveries possible in this area.

Biophysics - the application of physics to biological problems. Biophysics includes studies of proteins and DNA at the molecular level as well as studies of the human body as a mechanical system and the design of artificial limbs.

Chemical physics - the interface between physics and chemistry. This area is important for the development of lasers and for the study of surfaces, polymers, and fluids.

Geophysics - the physics of the earth and planets, including seismology (the study of earthquakes), hydrology (the study of water on and below the surface), and volcanology (volcanoes).

Low-temperature physics - the study of phenomena such as super-conductivity and superfluidity that occur at temperatures near absolute zero. Cryogenic (extreme low-temperature) devices have practical importance in generating magnetic fields and in circuits that will be needed in future computers.

Medical physics - the application of physics to medical practice, including uses of radiation, ultrasound, and sophisticated imaging techniques such as magnetic resonance imaging (MRI).

Nuclear physics - the study of the nucleus of the atom, its radioactivity (including medical applications), and nuclear energy. Tools of the nuclear physicist include accelerators and nuclear reactors.

Optics - the study of light (including the invisible ultraviolet and infrared radiation). Optical physicists often work with lasers and are engaged in the optical transmission of information via thin fibers and in the design of optical "circuits" for future computers.

Particle physics - the study of the smallest, most elemental building blocks of nature and the basic forces of nature. The "microscopes" of the particle physicist are enormous particle accelerators. (Particle physics is also called high-energy physics.)

Physics education - Teachers experience the excitement and fulfillment of educating others about all the fields of physics.

Plasma physics - the study of electrically charged (ionized) gases, sometimes called the fourth state of matter beyond solids, liquids, and gases. Plasma physicists are pursuing the possibility of controlled thermonuclear energy on earth. They also contribute to astrophysics.

Rheology - the study of the flow of viscous (thick, sticky) materials and mixtures of materials. The interests of rheologists include the flow of blood in the body, the flow of materials in a food-processing plant, and the flow of Arctic glaciers.

Solid-state physics - the study and application of the electric, magnetic, optical, and acoustic properties of solid matter. Integrated circuits are the product of solid-state physics.

Vacuum physics - the study and applications of vacuums, volumes nearly free of matter. Vacuums are important in many manufacturing processes and in experimental devices such as accelerators.

Some of these fields are taught in our department. Some are taught by other departments on the Norman campus or at the Health Science Center in Oklahoma.