

HANDBOOK FOR UNDERGRADUATE MAJORS

Department of Physics and Astronomy

Roster and Directory
Departmental Committees, Duties, and Organizations
Honors and Awards

Curricula and Suggested Schedules for

BACHELOR OF ARTS IN ASTRONOMY

BACHELOR OF SCIENCE IN ASTRONOMY

BACHELOR OF ARTS IN PHYSICS

BACHELOR OF SCIENCE IN PHYSICS

BACHELOR OF SCIENCE IN ENGINEERING PHYSICS

SCHOOL OF BUSINESS – CONCENTRATION IN PHYSICS

Planned Schedule of Courses Open to Majors

Course Numbering System

Research and Graduate Programs

The University of Kansas

Lawrence, Kansas 66045

August 2011

TABLE OF CONTENTS

<i>Subject</i>	<i>Page</i>
Roster and Directory	1-2
Departmental Committees and Organizations	3
General Information.....	4-5
Honors and Awards for Undergraduates	6-7
AP, IB Credit	8
Dantes Credit and Credit by Exam	9
Degree Requirements and Suggested Schedules	10
Astronomy	10-13
Physics	14-22
Engineering Physics	23-31
General Education Electives for Engineering Physics.....	32
Minor in Physics, Astronomy, Astrobiology, Business Concentration in Physics.....	33-34
Schedule of Course Offerings	34-37
Course Numbering System	38

UNDERGRADUATE RESEARCH IN ASTRONOMY AND PHYSICS

Students majoring in any of the programs in the department are encouraged to explore the possibilities for Undergraduate Research. Students may receive credit for their research experience; indeed, most of our degree programs require completion of at least one credit of undergraduate research. The courses for research enrollment are ASTR 390, *Undergraduate Problems*, ASTR 597, *Analysis in Astrophysics*, ASTR/PHSX/EPHX 503, *Undergraduate Research*, or ASTR/PHSX/EPHX 501, *Honors Research*.

In some cases, faculty with funded research may be able to provide a modest salary if the project is of direct assistance to their research. In addition there are University awards for undergraduate research. Information on these is available in the Department Office and from the faculty.

Any faculty member in the department may be able to provide research opportunities for undergraduates. Students may approach any faculty member whose work they think will be interesting to request an opportunity to enroll in supervised research. Presentations at SPS and in PHSX 150 will introduce students to the ongoing research programs of the department. Faculty members with routinely available research opportunities for undergraduates post descriptions on the department web page at www.physics.ku.edu. Look for the “Research Opportunities” button under the “Undergraduate Program” heading.

ROSTER AND DIRECTORY

PHONE*	NAME	ROOM
3910	Anthony–Twarog, Barbara J., Prof. (Ph.D. Yale 1981) <i>Astrophysics, Stellar Astronomy</i> bjat@ku.edu	2058b Mal
1943	Antonik, Matthew, Asst. Prof. (Ph.D. Maine 1994) <i>Biophysics; Experimental Single Molecule Physics</i> antonik@ku.edu	2061 Mal
3953	Baringer, Philip S., Prof. (Ph.D. Indiana 1985) ASSOCIATE CHAIR <i>Experimental Physics; Elementary Particle Physics</i> baringer@ku.edu	4075 Mal
4742	Bean, Alice L., Prof. (Ph.D. Carnegie–Mellon 1987) <i>Experimental Physics; Elementary Particle Physics</i> abean@ku.edu	4087 Mal
4741	Besson, David, Prof. (Ph.D. Rutgers 1986) <i>Experimental Physics; Elementary Particle Physics</i> zedlam@ku.edu	5069 Mal
6224	Chiu, Hsin-Ying, Asst. Prof. (Ph.D. California Institute of Technology, 2009) <i>Experimental Condensed-Matter Physics, Nanoscience and Nanotechnology</i> chiu@ku.edu	1075 Mal
4739	Cravens, Thomas E., Prof. (Ph.D. Harvard 1975) <i>Space Physics; Plasma Physics</i> cravens@ku.edu	60501 Mal
	Dreschhoff, Gisela, Adjunct Assoc. Prof. (Dr. of Science Tech. U. of Braunschweig, Germany 1972) <i>Geophysics, Energy Storage in Solids</i> giselad@ku.edu	
4740	Feldman, Hume Prof. (Ph.D. State Univ. of New York, Stony Brook, 1989) <i>Cosmology, Astrophysics</i> feldman@ku.edu	6070a Mal
4579	Fischer, Chris, Assoc. Prof. (Ph.D. Univ. of Michigan, 2000) <i>Biophysics</i> shark@ku.edu	2056a Mal
5831	Han, Siyuan, Prof. (Ph.D. Iowa State, 1986) <i>Experimental Condensed-Matter Physics</i> han@ku.edu	1077 Mal
5098	Hawley, Steven A., Prof. (Ph.D. Univ. of California, Santa Cruz 1977) <i>Astrophysics, Interstellar Medium, Active Galaxies</i> sahawley@ku.edu	2056cMal
6356	Kong, Kyoungchul (K.C.) Asst. Prof. (Ph.D. Univ. of Florida 2006) <i>Theoretical Particle Physics</i> kckong@ku.edu	6050cMal
	Laird, Claude, Courtesy Assoc. Prof. (Ph.D. Kansas 1986) <i>Geophysics (Haskell Indian Nations University)</i> claird@ku.edu	
4591	Marfatia, Danny, Assoc. Prof. (Ph.D. Univ. of Wisconsin, Madison, 2001) <i>Theoretical Particle Physics</i> marfatia@ku.edu	6070b Mal
2728	McElwee, Carl D., Courtesy Prof. (Ph.D. Kansas 1970)	230 Hamb
2097	<i>Geophysics, Magnetic Properties of Solids</i> cmcelwee@ku.edu	
4025	Medvedev, Mikhail V. (Misha) , Assoc. Prof. (Ph.D. San Diego, California, 1996) <i>Theoretical Astrophysics, Plasma and Space Physics</i> medvedev@ku.edu	3085 Mal

3037	Melott, Adrian L., Prof. (Ph.D. Texas 1981) <i>Astrophysics; Astrobiology</i>	melott@kusmos.phsx.ukans.edu	5075 Mal
3949	Murray, Michael J., Assoc. Prof. (Ph.D. Pittsburgh, PA 1989) <i>Relativistic Heavy Ion Physics</i>	mjmurray@ku.edu	4073 Mal
3408	Ralston, John P., Prof. (Ph.D. Oregon 1980) <i>Elementary Particle Physics and Particle Astrophysics</i>	ralston@ku.edu	6050h Mal
4099	Rudnick, Gregory, Asst. Prof. <i>Astrophysics, Observational Galactic Astronomy</i>	grudnick@ku.edu	2056b Mal
4626	Sanders, Stephen J., Prof. (Ph.D. Yale 1977) DEPARTMENT CHAIRPERSON <i>Experimental Nuclear Physics</i>	ssanders@ku.edu	1082b Mal
5274	Shandarin, Sergei, F., Prof. (Ph.D. Moscow Physical Technical Institute 1971) <i>Cosmology, Large– Scale Structure, Non– Linear Dynamics</i>	sergei@ku.edu	6070c Mal
5273	Shi, Jicong (Jack), Assoc. Prof. (Ph.D. Houston 1991) <i>Non–Linear Dynamics, Accelerator Beam Dynamics</i>	jshi@ku.edu	3079 Mal
5163	Twarog, Bruce A., Prof (Ph.D. Yale 1980) <i>Astrophysics of Galaxies</i>	btwarog@ku.edu	2058d Mal
5231	Wilson, Graham W., Assoc. Prof. (Ph.D. University of Lancaster 1989) <i>Experimental Physics, Elementary Particle Physics</i>	gwwilson@ku.edu	5071 Mal
3240	Wu, Judy Zhihong, Distinguished Prof. (Ph.D. Houston 1993) <i>Many–Body Theory, Superconductivity, Liquid Helium</i>	jwu@ku.edu	1076 Mal
1938	Zhao, Hui, Asst. Prof. (Ph.D. Beijing China 2000) <i>Condensed Matter Physics</i>	huizhao@ku.edu	1073 Mal

Administrative Staff

4626	Hubbel, Kim (Dept. Secretary)	khubbel@ku.edu	1082 Mal
5832	Fay, Doug (Accountant I)	dfay@ku.edu	1082d Mal
1226	Hunt-Ward, Tizby (Program Asst.)	tizby@ku.edu	6050k Mal
1225	Leahy, Teri (Office Supervisor/Graduate)	tleahy@ku.edu	1082c Mal

Director of Laboratories

3937	Curry, Robert	curry@ku.edu	2057 Mal
------	---------------	--	----------

*These are the last four digits of the campus telephone numbers, e.g. 785–864–3801.

Departmental Committees and Organizations

Astronomy Associates Of Lawrence: Astronomy Associates of Lawrence is an organization of students and townspeople interested in Astronomy for the fun of it. This organization elects its own officers. Faculty Advisor: Prof. Bruce Twarog

Departmental Assembly: The constituted body for full departmental meetings is the “Departmental Assembly.” The Department provides for the inclusion of regularly enrolled students in both its Departmental Assembly and its policy-making committees. The number of students in each body is at least 20 percent of the number of faculty members who hold the rank of instructor or above and who serve on that body. The Departmental Assembly consists of: entire faculty, plus the student members of the Committees on Graduate Studies, Undergraduate Studies plus one “at-large” student member.

Engineering Council: A representative elected each year by students majoring in Engineering Physics.

Engineering Physics Student Organization: PESO, the engineering physics student organization, is a club for students with interests in physics, engineering, or both fields of study. Prof. Steve Hawley is the adviser.

Graduate Studies: Seven faculty members appointed by the department chairman and two graduate students from PHSX elected by the graduate students in the department.

ΣΠΣ And SPS: The Society of Physics Students is open to all persons with an interest in physics. Sigma Pi Sigma (ΣΠΣ) is the physics honor society, within SPS, with scholastic requirements for membership. SPS/ΣΠΣ is a member society of the *American Institute of Physics* This organization elects its own officers. Faculty Adviser, Prof. Chris Fischer.

Undergraduate Studies: Six members appointed by the department chairman, two students elected by undergraduate majors in the Department, plus the Associate Chair, Prof. Phil Baringer, and Laboratory Directory, Mr. Bob Curry.

Faculty Advisers for Students Majoring in the Department

Coordinator
U.G. Astronomy B.A. and B.S. – Profs.

Barbara Anthony-Twarog
Barbara Anthony-Twarog and Bruce Twarog

Engineering physics and physics majors are assigned to advisors based on students’ last names:

Engineering Physics:

A-K: Prof. Hawley
L-Z: Prof. Fischer

Physics (College) B.A. and B.S.:

A - D: Prof. Medvedev
E - L: Prof. Antonik
M - P: Prof. Besson
Q - Z: Prof. Shandarin

Physics Graduate Students – Prof. Rudnick

Departmental Honors Coordinator – Prof. Barbara Anthony-Twarog

GENERAL INFORMATION

We've assembled some general information about the Department of Physics and Astronomy which students may find useful.

The Department occupies much of the west wing of Malott Hall. The main office for the Department is in 1082. This is the place to go if you need to change a section, (though you will have to document a necessity for that!) or leave a message or paper for a faculty member or teaching assistant. The office is generally open from 8:00 a.m. through 5:00 p.m. and is managed by Ms. Teri Leahy (1082c). You are likely to first encounter staff member Ms. Kim Hubbel as you walk in. The Accounting Office (1082d) is staffed by Mr. Doug Fay.

The laboratories for the introductory physics courses are supervised by our Director of Laboratories, Mr. Robert Curry. His office is 2057 Malott. He approves make-ups labs, among other things.

The Chair of the Department is Professor Stephen J. Sanders; Ms. Hubbel keeps his appointment calendar. The Associate Chair is Professor Phil Baringer; his office is located in 4075.

Tutoring: For introductory physics classes, tutors are available in Room 1089; see the posted schedule. There may or may not be ASTR 191 tutoring available; ask your instructor.

The Department keeps a list of names of persons who arrange for private tutoring; the list can be found inside the Department office. You may not contract with someone who is grading your work for a class or is your TA for a lab.

Computers: Students in upper division courses (500 or higher) will very likely need access to advanced labs and other specialized facilities. We maintain a computer room for our majors (1087 Malott), which contains two PCs and a printer. Instructors can facilitate access to this room by authorizing a combination for your use of the Omnilock on the door. Ms. Teri Leahy maintains the records of these combination authorizations, as well as keys for other laboratories and facilities.

The Department coordinates most of its homepage links through our "front door" home page at <http://www.physics.ku.edu>.

Where To Hand Things In: Lab reports for the introductory Physics courses go in *wooden drop boxes on the wall near the drinking fountain at the north end of the 2nd floor hallway*. Other instructors may specify alternate procedures for handing in work, such as asking you to put papers into their mailbox. Mailboxes are all in the Department office, 1082 Malott. Turn to your left as you enter the main office, and you'll see a rack of wooden mail boxes. Faculty boxes are towards the right end of this rack. If you need something date-stamped before you turn it in, or aren't sure how to find the correct mailbox, ask one of the office staff for help.

Students with Disabilities: The staff of Disability Services (part of the Academic Achievement and Access Center) 22 Strong, (785) 864-2620, coordinates accommodations and services for KU courses. If you have a disability for which you may request accommodation in KU classes and have not contacted them, please do as soon as possible. Please also see the professor privately in regards to that particular course.

Departmental Assessments and Awards: All courses, including our laboratory courses, are assessed by surveys at the end of the semester. Your constructive criticisms are very important. Teaching Assistants may receive awards based on student comments, and there is an award given to a teaching faculty member each spring as well. Watch for nomination materials near the end of the semester.

Academic Misconduct, Fairness and Privacy Issues: Any work presented as your own, must be your own. Beyond the obvious requirements that quizzes and tests must be completed without consultation or conversation with classmates, this also applies to homework (it must be your work, and identifiable as your own work, even if you have studied with friends) and to term papers, in which published material must be properly attributed. Penalties imposed by the College for violations of these policies range from reduction of grade, to suspension and expulsion.

The complementary issue to misconduct is fairness; you have a right to expect that your work is evaluated fairly and impartially. You may also expect to have adequate feedback about your performance in the course throughout the semester. You have a right to know, in advance, the criteria by which grades are determined in the class. Any concerns you have about the fairness with which your work is evaluated ought to be addressed to your instructor and, if necessary, to the Department chair or associate chair.

You also have a right to expect protection of your privacy -- for that reason, your grade cannot be given out over the telephone or by email, and can only be given by our office staff if you have your ID with you.

University Policies Concerning Consenting Relationships: University policy and accepted professional standards of ethics mean that there should be no romantic or sexual relationships between a student and an instructor (this includes faculty and teaching assistants) with grading or supervisory authority over that student. The university also has strong rules prohibiting ethnic, racial or sexual harassment. The Department of Physics and Astronomy is committed to a safe and equitable learning environment for all of our students, and we stand firmly behind these rules. Further information can be found in the student handbook at:

<http://www.studenthandbook.ku.edu/>

If You Have Problems Or Concerns: You should feel free to consult ANY faculty member of this Department if you have any questions or concerns about possible misconduct or harassment on the part of any member of the Department. A full list of faculty names and office numbers is posted in the hall between Rooms 1086 and 1088 Malott, or is available from the office staff in 1082 Malott or at

<http://www.physics.ku.edu/faculty/>

Student Organizations: Successful completion of a challenging major is more likely if you develop friendships and connections with others in your discipline. There are three organizations designed for student participation: Society of Physics Students (SPS), PESO for Engineering Physics and Astronomy Associates of Lawrence (AAL). Ask an instructor or inquire in the departmental office about joining.

In addition, all members of the department are welcome to unwind and visit in our Friday afternoon social hour which typically starts around 4:00 p.m. Coffee and cookies are served. SPS is the "official" sponsor of this gathering but it is a department-wide social event. Signs are posted around the department about the time and place for these gatherings.

Honors and Awards for Undergraduates

Honors Studies In The College Of Liberal Arts & Sciences

To identify gifted and well-prepared students, the University offers special, smaller and deeper “honors” sections of many classes. Students who have scored well on the National Merit Scholarship Qualifying exam or the American College Test are eligible for Honor Studies. Others may be admitted to honors sections of a particular course by permission of the department or instructor. Honors courses offered in the Department for majors are PHSX 213, PHSX 214, ASTR 391 and PHSX/EPHX 501.

Departmental Honors

A student who plans to graduate with departmental honors must file a *Declaration of Intent Form* with the Departmental Honors Coordinator, preferably during his/her junior year but in any case no later than enrollment for the final undergraduate semester. All of our department’s honors requirements include student research, for which results shall be presented in written form and accepted by three members of the Department faculty. Additional requirements specific to each degree are:

Astronomy: Qualified students earning either a B.A. or a B.S. degree in the College of Liberal Arts and Sciences with a major in astronomy may graduate with Honors in Astronomy by fulfilling the following requirements: (1) By the end of the candidate's final semester, achieve a minimum GPA of 3.25 overall and 3.5 in the major, in all courses taken in residence and elsewhere; (2) Complete at least 24 semester hours of astronomy and physics courses numbered 500 or above, including undergraduate research represented by 4 hours of credit in ASTR 596, 597, or ASTR 503, 501. A grade of B or better must be earned in ASTR 596, 597, PHSX 503, or 501

Engineering Physics: Qualified students earning a B.S. in engineering physics may graduate with Departmental Honors by fulfilling the following requirements: (1) By the end of the candidate’s final semester, achieve a minimum GPA of 3.5 in major courses taken in residence and elsewhere; (2) complete at least 1 credit hour of undergraduate research as represented by achievement of a grade of B or better in PHSX/EPHX 501 or 503.

Physics : Qualified students earning either a B.A. or a B.S. degree in the College of Liberal Arts and Sciences with a major in physics may graduate with Honors in Physics by fulfilling the following requirements: (1) By the end of the candidate's final semester achieve a minimum GPA of 3.25 overall and 3.5 in the major, in all courses taken in residence and elsewhere; (2) Complete at least 24 semester hours of physics courses numbered 500 or above and undergraduate research represented by 4 hours of credit in PHSX 503, Undergraduate Research, or PHSX 501, Honors Research. A grade of B or better must be earned in PHSX 503 or 501.

Outstanding Teaching Assistant: Three T.A.’s are selected each year and are given a monetary award paid from the *Emery E. Slosson Fund*. Awardees shall be restricted to those teaching assistants (graduate or undergraduate) who have held at least quarter-time appointments during both semesters of the current academic year. The selection committee shall consist of the Director of Laboratories and the Associate Chairman. Their selections shall be reported to the Committee on Undergraduate Studies. The Director of Laboratories shall request evaluations from all course coordinators and any other faculty supervising teaching assistants. Evaluations shall be on the basis of preparation for teaching assignments and in grading and recording duties, and interaction with students in effectively presenting the material and in assisting them patiently and pleasantly. Strong consideration shall be given to performance beyond the call of duty.

N. Wyman Storer Award For Service To Astronomy: This award, a memorial to the late *Professor N. Wyman Storer*, is presented to the senior in the Department expected to graduate in May or the following December who has provided services to the astronomy program at the University of Kansas in excess of what can be expected of a good student or has an outstanding record as a student in Astronomy. The Director of the *Tombaugh Observatory* and another faculty member shall select the recipient and report their selection to the Committee on Undergraduate Studies.

Stranathan Award: A gift by the late *Professor James D. Stranathan* enables the Department to designate its outstanding senior-to-be physics major as a recipient of the *Stranathan Award* which includes a cash stipend for each of the students' remaining two semesters. The award is based primarily on the student's over-all grade point average. The recipient must (1) have completed sufficient work to be classified officially as a senior, (2) have somewhat more than one semester's work remaining for the Bachelor's degree, (3) have at least 30 semester-hours of credit for work taken at the University of Kansas, and (4) have at least ten semester – hours credit in physics courses open only to juniors and seniors taken at the University of Kansas.

Francis W. Prosser Award: This award, established through the generosity of the late Professor Frank Prosser, is given annually to a major in physics or engineering physics with at least 30 but no more than 59 credit hours completed after the spring term, and an overall GPA of 3.5 or better.

Hansel Scholarship: The family of Paul G. Hansel has endowed a fund enabling a scholarship meeting tuition and fees for one academic year for one student with a declared major in engineering physics. Preference is given to students who are Kansas residents, with Nebraska residents given consideration next. Preference is given to juniors.

Tombaugh Scholarship: Alumni of the astronomy program have generously contributed to the Clyde W. Tombaugh Fund, enabling a scholarship for students majoring in astronomy.

Badgley Scholarship: Mrs. Esther Weik Badgley has funded a scholarship to support the study of a young woman studying physics or a related field. This renewable scholarship will normally be awarded to an incoming freshman student in the department.

Other Honors Or Awards: Opportunities for off-campus awards such as the national annual Society of Physics Students/Sigma Pi Sigma Scholarship and other opportunities for honors, awards, scholarships, etc. for undergraduates that become available will be responded to by the Committee on Undergraduate Studies. The Committee will disseminate the information about such awards and consult those members of the faculty who may have special knowledge of the students being considered so that they can make appropriate recommendations.

Advanced Placement Credit in Physics

Exam – Physics B

AP Grade	KU equivalent credit awarded :
3 - 5	8 credit hrs PHSX 114 & 115

Exam – Physics C - Mechanics

AP Grade	KU equivalent credit awarded :
3 - 5	4 credit hrs, PHSX 211

Exam – Physics C – Electricity & Magnetism

AP Grade	KU equivalent credit awarded
3 - 5	4 credit hrs, PHSX 212

Advanced Placement Credit in Physics (starting Fall 2013)

Exam – Physics B

AP Grade	KU equivalent credit awarded :
3-5	8 credit hrs PHSX 114 & 115

Exam – Physics C - Mechanics

AP Grade	KU equivalent credit awarded :
3 - 5	4 credit hrs, PHSX 211, 1 credit hr PHSX 216

Exam – Physics C – Electricity & Magnetism

AP Grade	KU equivalent credit awarded
3 - 5	3 credit hrs, PHSX 212, 1 credit hr PHSX 236

DANTES Subject Tests Program

The University of Kansas awards equivalent credit to students who receive appropriate scores in the DANTES Subject Tests program. At present, established credit equivalences include:

Dantes Grade	Subject Area:	KU equivalent credit awarded
48	Astronomy	3 credit hours, Astronomy 191

Credit by Examination Policy

In principle, University rules permit students to seek credit by examination. Here's what is laid out at the University level:

The Registrar's Office assesses a fee for any attempt by a student for credit by examination (CbyE).

- The student may NOT be enrolled in the class for which they seek credit
- may not have previously completed the class here or elsewhere,
- may not have taken courses ABOVE the desired course in the same department or field.

In addition, it is important to know that some medical schools will NOT accept credit for physics courses obtained by examination.

Beyond those general rules, authority rests with departments and the Dean of CLAS to assign a grade and credit hours that result from a successful examination.

The department of physics and astronomy sets the following additional guidelines:

- Students requesting CbyE should plan to provide some basis for a prior **university-level** course in the material for the course
- We don't offer CbyE for PHSX 111 or ASTR 191; these courses are not taught to fixed syllabi and do not routinely include a comprehensive final. If a student has a reasonable case for a course taken elsewhere at a university level, the approach to take is more properly to request transfer credit. Please consult your adviser or the associate chair for undergraduate studies (Prof. Baringer) or the chair of the undergraduate committee (Prof. Besson)
- The mechanism will be for students to take the comprehensive final set by the current semester's instructors at the end of the semester at the time and place that the final is administered for that course. Students should expect to provide photo identification at the time of the examination.
- We cannot award laboratory credit by this mechanism, so students required to complete the 4 credit hours courses PHSX 114, 115, 211, or 212, will still be short the required laboratory credit in the event of a successful CbyE.

Bachelor of Arts in Astronomy

General Education Requirements (63 credits)		Hours
English	ENGL 101 AND ENGL 102 (OR 105) AND ONE of ENGL 203 , 205, 209, 210, or 211	9
Western Civil.	HWC 204 (OR 114) AND HWC 205 (OR 115)	6
Humanities	Three courses from the <i>Principal Course Distribution List</i>	9
Social Science:	Three courses from the <i>Principal Course Distribution List</i>	9
Natural Science & Mathematics	CHEM 184 and one course from Biological or Earth Science topical group (MATH 121 is explicitly part of the mathematics requirements)	8
Oral Comm. & Logic	COMS 130 (131) or 230; PHIL 148 or 310 or COMS exemption/proficiency	3
Non-western Culture	From PCNW course list for CLAS requirements	3
Foreign Language	Level I, II, III and IV or proficiency	16

Foundational Physics & Mathematics (18.5 credits)		Hours
PHSX 150	Seminar in Physics, Astronomy and Engineering Physics	0.5
PHSX 211 or 213	General Physics I (213 is honors/majors equivalent)	4
PHSX 212 or 214	General Physics II (214 is honors/majors equivalent)	4
MATH 121	Calculus I	5
MATH 122	Calculus II	5

Astronomy requirements for major (16 credits, 15 or 16 at jr/sr level)		Hours
ASTR 196 or 596	Intro. Astronomy Lab or Observational Astrophysics. ASTR 596 does not satisfy CLAS laboratory science requirement	1
ASTR 391	Physical Astronomy	3
ASTR 390	Undergraduate Problems (by appointment with faculty – research or directed readings)	3
ASTR 591	Stellar Astronomy	3
ASTR 592	Galactic & Extragalactic Astronomy	3
PHSX 693 or ASTR/PHSX 691 or GEOL 572	Gravitation & Cosmology, Astrophysics I, or Geophysics Students must meet the prerequisites for these courses.	3

Additional Notes:

- 120 credits are required for graduation, of which 45 must be at junior/senior level (courses numbered 300 or higher). Specific requirements for this major comprise 97.5 credit hours, leaving 22.5 credits to be filled with elective choices to meet the 120 credit standard for graduation. Specific requirements include 15-16 jr/sr credit hours; students must take 29 to 30 additional credit hours at the junior senior level to satisfy the regents' requirement.

Suggested Schedule B.A. Astronomy

Fall Semester

Spring Semester

Freshman Year

MATH 121, <i>Calculus I</i>	5	MATH 122, <i>Calculus II</i>	5
ENGL 101, <i>Composition</i>	3	ENGL 102, <i>Critical Reading & Writing</i>	3
PHSX 150 , <i>Seminar in Physics, Astronomy & Engineering Physics</i>	0.5	PHSX 211/213, <i>General Physics I</i> (majors are encouraged to take 213)	4
CHEM 184, <i>Found. Chemistry I</i>	5	General Education requirements	3
		** ASTR 196 lab may be taken with or after ASTR 391; ASTR 596 will be offered in fall semesters of odd-numbered years.	
	16.5		15

Sophomore Year

PHSX 212 or 214 , <i>General Physics II</i>	4	ENGL elective	3
General Education requirements	3	General Education requirements	3
Foreign Language 1	5	Foreign Language 2	5
COMS/PHIL elective	3	Astronomy 391	3
	15		14

Junior Year

ASTR 591 or astronomy elective	3	ASTR 592 or astronomy elective	3
ASTR 196 <i>Intro. Astron. Lab</i> or ASTR 596, <i>Observational Astrophysics</i>	1	ASTR 390	1
Foreign Language III	3	Foreign Language IV	3
Western Civ. I	3	Western Civ. II	3
General Education requirements	6	General Education requirement or electives	6
** PHSX 693 is offered @ 2 years			
** GEOL 572 is taught in the fall			
	16		16

Senior Year

ASTR 591 or astronomy elective	3	ASTR 592 or astronomy elective	3
Non-western Culture course	3	ASTR 390	1
ASTR 390	1		
General Education/electives	9	General Education / electives	9-12
** ASTR/PHSX 691 is taught in the fall semester in even-numbered years		** ASTR 390 is arranged between faculty and students for 1 or more credits	
	16		13-16

Courses that are only offered in semester listed are annotated in boldface type.

Bachelor of Science in Astronomy

General Education Requirements (27 credits)		Hours
English	ENGL 101 AND ENGL 102 (OR 105) AND ONE of ENGL 203 , 205, 209, 210, 211, or 362	9
Western Civil.	HWC 204 (OR 114) AND HWC 205 (OR 115)	6
Humanities	Two Courses, one MUST be from the <i>Principal Course Distribution List</i>	6
Social Science:	Two Courses, one MUST be from the <i>Principal Course Distribution List</i>	6

Foundational Physics & Mathematics (18.5 credits)		Hours
PHSX 150	Seminar in Physics, Astronomy & Engineering Physics	0.5
PHSX 211 or 213	General Physics I (213 is honors/majors equivalent)	4
PHSX 212 or 214	General Physics II (214 is honors/majors equivalent)	4
MATH 121	Calculus I	5
MATH 122	Calculus II	5

General Science Requirements (8 to 9 credits)		Hours
Chemistry	CHEM 184 (or 185) Foundations of Chemistry	5
Computer Sci.	EECS 138 (3), Intro. to Computing or EECS 168 (4) Programming I Fortran or C++ are accepted languages for EECS 138	3-4

Advanced Mathematics (11 credits, 3 – 6 at jr/sr level)		Hours
MATH 223	Vector Calculus	3
MATH 290	Elementary Linear Algebra	2
MATH 320	Elem. Differential Equations.	3
Math elective	ONE Course from the following list PHSX 518, 718, MATH 465, 526, 530, 558, 581, 590, 628, 646, 647, 648, 660, 661, OR any 700-level MATH lecture course except for MATH 701 and 715.	3

Advanced Physics requirements for major (23 credits, all at jr/sr level)		Hours
PHSX 313	General Physics III	3
PHSX 316	Intermediate Physics Laboratory (with or after PHSX 313)	1
PHSX 511	Intro. Quantum Mechanics	3
PHSX 516 or 536	Physical Measurements or Electronic Circuits & Measurements	4
PHSX 521	Mechanics I	3
PHSX 531	Electricity & Magnetism	3
PHSX 671	Thermal Physics	3
PHSX elective	Any physics lecture or laboratory course at 500 level or higher. GEOL 572 and ASTR 795 are also accepted for this requirement.	3

Astronomy requirements for major (20 credits, all at jr/sr level)		Hours
ASTR 391	Physical Astronomy	3
ASTR 503	Undergraduate Research. 1 credit is required for major; more may be taken. More than 1 credit of research may be required for departmental honors.	1
ASTR 591	Stellar Astronomy	3
ASTR 596	Observational Astrophysics	1
ASTR 592	Galactic & Extragalactic Astronomy	3
ASTR 691	Astrophysics I	3
ASTR 692	Astrophysics II	3
PHSX 693	Gravitation & Cosmology	3

These requirements comprise 107.5 – 108.5 credit hours; 120 credits are required for graduation, leaving 11.5 to 12.5 credits free for elective choices. 46 to 49 credit hours are explicitly required at the junior/senior level of coursework, so there is no problem meeting the regents' requirement for 45 credit hours at jr/sr level.

ASTR 596 will be taught in odd-numbered fall semesters concurrent with ASTR 591.

Students who wish to major in both physics and astronomy must meet the requirements of both degrees, plus an additional requirement: 15 credits must be unique for each degree.

Suggested Schedule B.S. Astronomy

Fall Semester

Spring Semester

Freshman Year

MATH 121, <i>Calculus I</i>	5	MATH 122, <i>Calculus II</i>	5
ENGL 101, <i>Composition</i>	3	ENGL 102, <i>Critical Reading & Writing</i>	3
PHSX 150 , <i>Seminar in Physics, Astronomy & Engineering Physics</i>	0.5	PHSX 211/213, <i>General Physics I</i> (majors are encouraged to take 213)	4
CHEM 184, <i>Found. Chemistry I</i>	5	Electives or General Ed.	3
Electives or General Ed.	3		
	16.5		15

Sophomore Year

PHSX 212 or 214 , <i>General Physics II</i>	4	MATH 320, <i>Differential Equations</i>	3
Electives or General Education	3	ENGL elective	3
MATH 290, <i>Elem. Linear Algebra</i>	2	PHSX 313, <i>General Physics III</i>	3
MATH 223, <i>Vector Calculus</i>	3	PHSX 316, <i>Intermediate Physics Lab</i>	1
EECS 138, <i>Intro to Computing</i> or EECS 168, <i>Programming I</i>	3-4	Electives or General Ed.	3
		ASTR 391 , <i>Physical Astronomy</i>	3
	15-16		16

Junior Year

PHSX 521 , <i>Mechanics I</i>	3	PHSX 511 , <i>Intro. Quantum Mechanics</i>	3
Math elective	3	Western Civ. II	3
ASTR 591 and 596 or 691	3-4	ASTR 592/692	3
Western Civ. I	3	Electives	3
PHSX 516 , <i>Physical Measurements</i> or electives	4	PHSX 536 , <i>Elec. Circ. Meas. & Design</i> or electives (Astronomy B.S. majors take PHSX 536 or 516)	4
	16		16

Senior Year

PHSX 671 , <i>Thermal Physics</i>	3	ASTR 503, <i>Undergraduate Research</i>	1
PHSX 531 , <i>Electricity & Magnetism</i>	3	ASTR 592/692	3
ASTR 691 or 591+596	3-4	Electives	9
Electives	6	PHSX elective	3
	15		16

Courses that are only offered in semester listed are annotated in boldface type.

Bachelor of Arts in Physics

General Education Requirements (63 credits)		Hours
English	ENGL 101 AND ENGL 102 (OR 105) AND ONE of ENGL 203 , 205, 209, 210, or 211	9
Western Civil.	HWC 204 (OR 114) AND HWC 205 (OR 115)	6
Humanities	Three courses from the <i>Principal Course Distribution List</i> . For UKanTeach students, HIST 136 must fill the <i>Historical Studies</i> subgroup requirement	9
Social Science:	Three courses from the <i>Principal Course Distribution List</i>	9
Natural Science & Mathematics	CHEM 184 is recommended, as well as one course from Biological or Earth Science topical group (MATH 121 is explicitly required in mathematics requirements).	8
Oral Comm. & Logic	COMS 130 (131) or 230; PHIL 148 or 310 or COMS exemption/proficiency	3
Non-western Culture	From PCNW course list for CLAS requirements	3
Foreign Language	Level I, II, III and IV or proficiency	16

Foundational Physics & Mathematics (18.5 credits)		Hours
PHSX 150	Seminar in Physics, Astronomy & Engineering Physics	0.5
PHSX 211 or 213	General Physics I (213 is honors/majors equivalent)	4
PHSX 212 or 214	General Physics II (214 is honors/majors equivalent)	4
MATH 121	Calculus I	5
MATH 122	Calculus II	5

Advanced Physics requirements for major (20 credits, all jr/sr)		Hours
PHSX 313	General Physics III	3
PHSX 316	Intermediate Physics Lab (take with or after PHSX 313)	1
PHSX 511	Intro. Quantum Mechanics	3
PHSX 521	Mechanics I	3
PHSX 531	Electricity & Magnetism	3
PHSX 536	Electronic Circuit Measurement & Design	4
PHSX elective	Any physics lecture or laboratory course numbered 500 or higher	3

Advanced Mathematics requirements for major (8 credits, 0 to 3 at jr/sr level)		Hours
MATH 223	Vector Calculus	3
MATH 290	Elementary Linear Algebra	2
MATH 220 or 320	Elementary Differential Equations; MATH 320 is recommended for physics & astronomy majors	3

Additional Notes:

- 120 credits are required for graduation, of which 45 must be at junior/senior level (courses numbered 300 or higher). Specific requirements for this major comprise 109.5 credit hours, including 20 jr/sr credit hours (increased by 3 if MATH 320 is taken). Students must take 22 to 25 additional hours as electives at the jr/sr level to satisfy this regents' requirement.
- The department also offers a Bachelor of Arts in Computational Physics. These requirements are listed in the Undergraduate Catalog of the University.

With a few modifications, students earning a bachelor of arts in physics may qualify for licensure to teach secondary physics at the time they graduate by following the UKanTeach curriculum. UKanTeach adds several pedagogic and a few general education requirements but is **otherwise indistinguishable** from other physics degrees, so students may feel equally well prepared for education, further research or study.

All content and education-related courses used to fulfill licensure requirements must be taken on a letter-grade basis.

Other requirements specific to UKanTeach licensure are:

PROFESSIONAL DEVELOPMENT COURSEWORK REQUIREMENTS: A minimum grade of C is required in all courses.		27
Liberal Arts & Sciences	LA&S 290 Approaches to Teaching Science and Math I	1
	LA&S 291 Approaches to Teaching Science and Math II	1
Curriculum & Teaching	C&T 360 Knowing and Learning in Science & Mathematics	3
	C&T 366 Classroom Interactions in Science & Mathematics	3
	C&T 448 Reading and Writing across the Curriculum	3
	C&T 460 Project-Based Instruction	3
	C&T 500 Student Teaching (6 hours) <i>Requires a 2.5 cumulative GPA in major and overall.</i>	6
	C&T 598 Special Topics Seminar	1
Research Methods	CHEM 598 or Equivalent course /experience approved by UKanTeach in Major Field of Study	3
History of Science	History of Science course approved by UKanTeach	3

Suggested Schedule B.A. Physics

Fall Semester

Spring Semester

Freshman Year

MATH 121, <i>Calculus I</i>	5	MATH 122, <i>Calculus II</i>	5
ENGL 101, <i>Composition</i>	3	ENGL 102, <i>Critical Reading & Writing</i>	3
PHSX 150 , <i>Seminar in Physics & Astronomy & Engineering Physics</i>	0.5	PHSX 211/213, <i>General Physics I</i> (majors are encouraged to take 213)	4
CHEM 184, <i>Found. Chemistry I</i>	5	Elective/General Education	3
Elective/General Education	3		
	16.5		15

Sophomore Year

PHSX 212 or 214 , <i>General Physics II</i>	4	PHSX 313, <i>General Physics III</i>	3
Third English Course	3	PHSX 316, <i>Intermed. Physics Lab</i>	1
MATH 223, <i>Vector Calculus</i>	3	MATH 220 or 320, <i>Differential Equations</i>	3
MATH 290, <i>Linear Algebra</i>	2	Foreign Language II	5
Foreign Language I	5	Elective/General Education	3
	17		15

Junior Year

PHSX 521 , <i>Mechanics I</i>	3	PHSX 511 , <i>Intro Quantum Mechanics</i>	3
Foreign Language III	3	PHSX 536 , <i>Elect. Circuits Meast. & Dsgn</i>	4
Western Civ. I	3	Western Civ. II	3
Elective/General Education	6	Foreign Language IV	3
		Elective/General Education	3
	15		16

Senior Year

PHSX 531 , <i>Electricity & Magnetism</i>	3	Physics elective course	3
Non-western Culture course	3	Electives or General Ed.	12
Elective/General Education	9		
	15		15

Courses that are only offered in the semester listed are annotated in boldface type.

Suggested Schedule B.A. Physics UKanTeach

Fall Semester

Spring Semester

Freshman Year

MATH 121, <i>Calculus I</i>	5	MATH 122, <i>Calculus II</i>	5
ENGL 101, <i>Composition</i>	3	ENGL 102, <i>Critical Reading & Writing</i>	3
PHSX 150 , <i>Seminar in Physics, Astronomy & Engineering Physics</i>	0.5	PHSX 211/213, <i>General Physics I</i> (majors are encouraged to take 213)	4
CHEM 184, <i>Found. Chemistry I</i>	5	PC I	3
LA&S 290, <i>Approaches to Teaching Science and Math I</i>	1	LA&S 291, <i>Approaches to Teaching Science and Math II</i>	1
	14.5		16

Sophomore Year

PHSX 212 or 214 , <i>General Physics II</i>	4	PHSX 313, <i>General Physics III</i>	3
C&T 360, <i>Knowing & Learning</i>	3	PHSX 316, <i>Intermed. Physics Lab</i>	1
MATH 223, <i>Vector Calculus</i>	3	MATH 220 or 320, <i>Differential Equations</i>	3
MATH 290, <i>Linear Algebra</i>	2	Foreign Language II	5
Foreign Language 1	5	PC II History of Science	3
	17		15

Junior Year

PHSX 521 , <i>Mechanics I</i>	3	PHSX 511 , <i>Intro Quantum Mechanics</i>	3
Foreign Language III	3	PHSX 536 , <i>Elect. Circuits Meast. & Dsgn</i>	4
Western Civ. I	3	Western Civ. II	3
English elective	3	Foreign Language IV	3
C&T 366, <i>Classroom Interactions</i>	3	CHEM598, <i>Research Methods</i>	3
	15		16

Senior Year

PHSX 531 , <i>Electricity & Magnetism</i>	3	Non-Western Culture Course	3
PHSX elective	3	C&T 500, <i>Student Teaching</i>	6
PC III	3	C&T 598, <i>Special Topics Seminar</i>	1
C&T 460, <i>Project-Based Instruction</i>	3	PC IV	3
C&T448, <i>Reading & Writing</i>	3		
	15		13

One principal course must be met through summer study or additional hours in one of these semesters.

Courses that are only offered in the semester listed are annotated in boldface type.

Bachelor of Science in Physics

General Education Requirements (27 credits)		Hours
English	ENGL 101, ENGL 102 (OR 105), and ONE of ENGL 203 , 205, 209, 210, 211, or 362	9
Western Civil.	HWC 204 (OR 114) and HWC 205 (OR 115)	6
Humanities	Two Courses, one MUST be from the <i>Principal Course Distribution List</i> (this requirement is slightly modified for students in the UKanTeach program)	6
Social Science:	TWO Courses, one MUST be from the <i>Principal Course Distribution List</i>	6

Foundational Physics & Mathematics (18.5 credits)		Hours
PHSX 150	Seminar in Physics, Astronomy and Engineering Physics	0.5
PHSX 211 or 213	General Physics I (213 is honors/majors equivalent)	4
PHSX 212 or 214	General Physics II (214 is honors/majors equivalent)	4
MATH 121	Calculus I	5
MATH 122	Calculus II	5

General Science Requirements (8 to 9 credits)		Hours
Chemistry	CHEM 184 (or 185) Foundations of Chemistry	5
Computer Sci.	EECS 138 (3), Intro. to Computing or EECS 168 (4) Programming I Fortran or C++ are accepted languages for EECS 138	3-4

Advanced Mathematics (11 credits)		Hours
MATH 223	Vector Calculus	3
MATH 290	Elementary Linear Algebra	2
MATH 320	Elem. Differential Equations.	3
Math elective	ONE Course from the following list PHSX 518, 718, MATH 465, 526, 530, 558, 581, 590, 628, 646, 647, 648, 660, 661, OR any 700-level MATH lecture course except for MATH 701 and 715.	3

Advanced Physics required for both options (24 credits)		Hours
PHSX 313	General Physics III	3
PHSX 316	Intermediate Physics Laboratory (with or after PHSX 313)	1
PHSX 511	Intro. Quantum Mechanics	3
PHSX 516 or 536	Physical Measurements or Electronic Circuits & Measurements	4
PHSX 521	Mechanics I	3
PHSX 531	Electricity & Magnetism	3
PHSX 671	Thermal Physics	3
PHSX elective	Any physics lecture or laboratory course numbered 500 or higher and not part of other specific requirements for the major.	3
PHSX research	PHSX 503, Undergraduate Research, or 501 (Honors). 1 credit is required for majors; more may be taken. More than 1 credit of research may be required for departmental honors	1

B.S. Physics candidates select one of the following options: pre-professional or interdisciplinary

Pre-Professional Option Requirements (13 credits)		Hours
PHSX 621	Mechanics II	3
PHSX 631	Electromagnetic Theory	3
PHSX 711	Quantum Mechanics	3
PHSX 516 or 536	Physical Measurements or Electronic Circuits & Measurements; students in this option track take both advanced laboratory courses	4

Interdisciplinary Option Requirements (12 to 15 credits)		Hours
PHSX	TWO of: PHSX 621, PHSX 631, PHSX 711, PHSX 516/536	6-7
Interdisciplinary science electives	Two semesters coursework in an allied science at 300-level or higher. Students must meet any prerequisites for these courses as part of elective hours. Courses approved to date are:	6-8

	CHEM 598, 622 or 646 (CHEM 598 open only to UKanTeach students)	
	BIOL 350, 400, 408, 412, 416, 600, 636, 638	
	GEOL 360, 562, 572, 575, 576, 577	

Additional Notes:

- Specific requirements for the physics B.S. comprise 101.5 to 102.5 credits for the pre-professional option, 100.5 to 104.5 credits for the interdisciplinary option, leaving 14.5 to 19.5 credits usable for elective courses; 120 credits are presently required for bachelor's degrees.
- Specific requirements for this degree include 42 to 45 credit hours at the junior/senior level if MATH 320 is taken as recommended. A few additional hours of elective coursework at the junior/senior level must be included as electives to meet the separate requirement set by the Regents for 45 credit hours of junior/senior coursework.
- Students who wish to major in both physics and astronomy must meet the requirements of both degrees plus additional requirements: 15 credits must be unique for each degree.

With a few modifications, students earning a bachelor of science in physics may qualify for licensure to teach at the time they graduate by following the UKanTeach curriculum. UKanTeach adds several pedagogic and a few general education requirements but is **otherwise indistinguishable** from a B.S. in physics, so students may feel equally well prepared for education, further research or study.

There are some specific differences:

- for the UKanTeach physics B.S. requirements the humanities general education requirement is as follows: ONE Course from the *Principal Course Distribution List* (see the *Undergraduate Catalog*) AND a history of science course approved by UKanTeach.
- All content and education related courses used to fulfill licensure requirements must be taken on a letter-grade basis by UKanTeach students.
- An additional requirement is CHEM 598 Research Methods (**OR** Equivalent Course /Experience Approved by UKanTeach in Major Field of Study). Students pursuing the interdisciplinary option may use this course as one of their interdisciplinary science electives.
- Additional requirements for licensure are:

PROFESSIONAL DEVELOPMENT COURSEWORK REQUIREMENTS: A minimum grade of C is required in all courses.		21
Liberal Arts & Sciences	LA&S 290 Approaches to Teaching Science and Math I	1
	LA&S 291 Approaches to Teaching Science and Math II	1
Curriculum & Teaching	C&T 360 Knowing and Learning in Science & Mathematics	3
	C&T 366 Classroom Interactions in Science & Mathematics	3
	C&T 448 Reading and Writing across the Curriculum	3
	C&T 460 Project-Based Instruction	3
	C&T 500 Student Teaching (6 hours) (<i>Requires a 2.5 cumulative GPA in major and overall.</i>)	6
	C&T 598 Special Topics Seminar	1

Suggested Schedule B.S. Physics, Pre-Professional Option

Fall Semester

Spring Semester

Freshman Year

MATH 121, <i>Calculus I</i>	5	MATH 122, <i>Calculus II</i>	5
ENGL 101, <i>Composition</i>	3	ENGL 102, <i>Critical Reading & Writing</i>	3
CHEM 184, <i>Found. Chemistry I</i>	5	PHSX 211/213, <i>General Physics I</i> (majors are encouraged to take 213)	4
Humanities Elective	3	Social Science Elective	3
PHSX 150 Seminar in Physics, Astronomy & Engineering Physics	0.5		
	16.5		15

Sophomore Year

PHSX 212 or 214, General Physics II	4	MATH 320, <i>Differential Equations</i>	3
ENGL elective	3	PHSX 501/503 <i>Undergrad Research</i>	1
MATH 290, <i>Elem. Linear Algebra</i>	2	PHSX 313, <i>General Physics III</i>	3
MATH 223, <i>Vector Calculus</i>	3	PHSX 316, <i>Intermediate Physics Lab</i>	1
EECS 138, <i>Intro to Computing</i> or EECS 168, <i>Programming I</i>	3-4	Humanities or Social Science Elective	6
	15-16		14

Junior Year

PHSX 521, Mechanics I	3	PHSX 511, Intro. Quantum Mechanics	3
Math elective	3	PHSX 621, Mechanics II	3
PHSX 516, Physical Measurements	4	PHSX 536, Elec. Circ. Meas. & Design	4
Western Civ. I	3	Humanities or Social Science Elective	3
Free Electives	3	Western Civ. II	3
	16		16

Senior Year

PHSX 711, Quantum Mechanics	3	PHSX 631, Electromagnetic Theory II	3
PHSX 531, Electricity & Magnetism	3	PHSX elective	3
PHSX 671, Thermal Physics	3	Free electives	10-11
Free electives	6		
	15		16-17

Courses that are only offered in the semester listed are annotated in boldface type.

Suggested Schedule B.S. Physics, Interdisciplinary Science Option

Fall Semester

Spring Semester

Freshman Year

MATH 121, <i>Calculus I</i>	5	MATH 122, <i>Calculus II</i>	5
ENGL 101, <i>Composition</i>	3	ENGL 102, <i>Critical Reading & Writing</i>	3
CHEM 184, <i>Found. Chemistry I</i>	5	PHSX 211/213, <i>General Physics I</i> (majors are encouraged to take 213)	4
Humanities Elective	3	Social Science Elective	3
PHSX 150 Seminar in Physics, Astronomy & Engineering Physics	.05		
	16.5		15

Sophomore Year

PHSX 212 or 214, General Physics II	4	MATH 320, <i>Differential Equations</i>	3
Third English Course	3	General Science background (further chemistry, intro. Biology or geology)	3-5
MATH 290, <i>Elem. Linear Algebra</i>	2	PHSX 313, <i>General Physics III</i>	3
MATH 223, <i>Vector Calculus</i>	3	PHSX 316, <i>Intermediate Physics Lab</i>	1
EECS 138, <i>Intro to Computing</i> or EECS 168, <i>Programming I</i>	3-4	Humanities or Social Science Elective	3
		PHSX 501/503 <i>Undergrad Research</i>	1
	15-16		14-16

Junior Year

PHSX 521, Mechanics I	3	PHSX 511, Intro. Quantum Mechanics	3
Math elective	3	Free Electives	6
Humanities or Social Science Elective	3	Physics lab or lecture (536, 621)	3-4
Western Civ. I	3	Western Civ. II	3
Free Electives	3		
	15		15-16

Senior Year

Physics lab or lecture course (516,711)	3-4	Interdisciplinary science elective	3-4
PHSX 531, Electricity & Magnetism	3	PHSX elective	3
PHSX 671, Thermal Physics	3	Physics course – lab or lecture (631,621,536)	3-4
Interdisciplinary science elective	3-4	Free Electives	6
Free Electives	3		
	15-17		15-17

Courses that are only offered in the semester listed are annotated in boldface type.

Suggested Schedule B.S. Physics (Pre-Professional Option) UKanTeach

Fall Semester

Spring Semester

Freshman Year

MATH 121, <i>Calculus I</i>	5	MATH 122, <i>Calculus II</i>	5
ENGL 101, <i>Composition</i>	3	ENGL 102, <i>Critical Reading & Writing</i>	3
CHEM 184, <i>Found. Chemistry I</i>	5	PHSX 211/213, <i>General Physics I</i> (majors are encouraged to take 213)	4
Humanities Elective	3	Social Science Elective	3
LA&S 290 <i>Approaches to Teaching Science & Math I</i>	1	LA&S 291 <i>Approaches to Teaching Science & Math II</i>	1
PHSX 150 Seminar in Physics, Astronomy & Engineering Physics	0.5		
	17.5		15

Sophomore Year

PHSX 212 or 214, General Physics II	4	MATH 320, <i>Differential Equations</i>	3
C&T 360 <i>Knowing & Learning</i>	3	English elective	3
MATH 290, <i>Elem. Linear Algebra</i>	2	PHSX 313, <i>General Physics III</i>	3
MATH 223, <i>Vector Calculus</i>	3	PHSX 316, <i>Intermediate Physics Lab</i>	1
EECS 138, <i>Intro to Computing</i> or EECS 168, <i>Programming I</i>	3-4	C&T 366 <i>Classroom Interactions</i>	3
		PHSX 503, <i>Undergraduate Research</i>	1
	15-16		14

Junior Year

PHSX 521, Mechanics I	3	PHSX 511, Intro. Quantum Mechanics	3
PHSX 516, Physical Measurements	4	PHSX 621, Mechanics II	3
PHSX elective	3	PHSX 536, Elec. Circ. Meas. & Design	4
Western Civ. I	3	CHEM598, <i>Research Methods</i>	3
Math elective	3	Western Civ. II	3
History of Science Course	3		
	19		16

Senior Year

PHSX 711, Quantum Mechanics	3	PHSX 631, Electromagnetic Theory II	3
PHSX 531, Electricity & Magnetism	3	C&T448, <i>Reading and Writing</i>	3
PHSX 671, Thermal Physics	3	C&T 500, <i>Student teaching</i>	6
Social Science elective	3	C&T 598, <i>Special Topics Seminar</i>	1
C&T 460, <i>Project-Based Instruction</i>	3		
	15		13

Courses that are only offered in the semester listed are annotated in boldface type.

Engineering Physics Required Courses and Suggested Schedules

The Bachelor of Science in Engineering Physics is offered in four concentrations – Aerospace Systems, Chemical Systems, Digital Electronic Systems, and Electromechanical Control Systems. This section of the Handbook lists the required courses and offers suggested schedules for meeting the requirements of the different concentrations. The required credits vary slightly depending on the concentration chosen, but average approximately 128 hours. The curriculum is challenging and it is important to be aware that many of the required courses, particularly at the junior/senior level, are offered only once a year. Students are urged to plan ahead in consultation with their advisor. Advising is required of engineering physics majors and enrollment is restricted until advising is complete. Although the Department makes every effort to keep this information current, it is important to be aware that the schedule of course offerings is subject to change with the potential that suggested courses may not be available as listed here or may be in time conflict with other suggested courses. It is also possible that enrollment in some courses may be limited. Again, the advisor can be helpful at exploring options in these cases. Furthermore, the following suggested schedules are built on the assumption that engineering physics students come to KU with the preparation in high school math, chemistry and physics to allow enrollment in MATH 121 and CHEM 184 or 150. If MATH 121, CHEM 184/150, or PHSX 211/213 is postponed the schedule can be significantly affected resulting in an increased probability of needing more than four years to complete the degree. All students in Engineering Physics are encouraged to consider taking at least one summer of course work.

In general, substitutions for the required courses are not available, although in a few cases substitutions have been approved, such as ME 312 Thermodynamics instead of C&PE 221 Thermodynamics. To assist in planning, the following suggested schedules include pre-approved alternatives where they exist. Also, courses that are only offered in the semester listed are annotated in boldface type.

Bachelor of Science in Engineering Physics, Aerospace Systems

General Education Requirements (26 credits)		Hours
English	ENGL 101 and ENGL 102	6
Chemistry	CHEM 184, Foundations of Chemistry, or CHEM 150 Chemistry for Engineers	5
Engineering Gen. education requirements	Courses from approved list in topical areas of: economics, ethics, communication, environmental concern and contemporary issues (see separate page)	15

Core Physics (26.5 credits)		Hours
PHSX 150	Seminar in Physics, Astronomy and Engineering Physics	0.5
PHSX 211 or 213	General Physics I (213 is honors/majors equivalent)	4
PHSX 212 or 214	General Physics II (214 is honors/majors equivalent)	4
PHSX 313	General Physics III	3
PHSX 316	Intermediate Physics Laboratory (with or after PHSX 313)	1
EPHX 516	Physical Measurements	4
EPHX 521	Mechanics I	3
EPHX 531	Electricity & Magnetism	3
PHSX 601	Design of Physical & Electronic Systems	4

Mathematics (18 credits)		Hours
MATH 121	Calculus I	5
MATH 122	Calculus II	5
MATH 223	Vector Calculus	3
MATH 290	Elementary Linear Algebra	2
MATH 220 or 320	Applied or Elementary Differential Equations.	3

Requirements specific for this option: Design Option in Aerospace Systems (56-57 credits)		Hours
Physics	EPHX 536, Electronic Circuit Measurement & Design	4
Aerospace Engr.	AE 245, Intro. to Aerospace Engineering	3
	AE 345, Fluid Mechanics or C&PE 511, Momentum Transfer or ME 510, Fluid Mechanics	3
	AE 421, Aerospace Computer Graphics (4) or ME 228, Computer Graphics (3)	3-4
	AE 445, Aircraft Aerodynamics and Performance	3
	AE 507, Aerospace Structures I	3
	AE 508 Aerospace Structures II (3) and AE 521, Aerospace System Design I (4) or AE 560 Spacecraft Systems (3) and AE 523, Space Systems Design (4)	3+4
	AE 545, Fundamentals of Aerodynamics	5
	AE 550, Dynamics of Flight I	3
	AE 551, Dynamics of Flight II	4
	AE 572, Fundamentals of Jet Propulsion	3
Engineering	C&PE 121, Intro. to Computers in Engineering, or EECS 138, Intro. to Computing or EECS 168, Programming I, or ME 208, Intro. to Digital Computational Methods in Mechanical Engr.	3
	C&PE 221 or ME 312, Basic Engineering Thermodynamics	3
	CE 301, Statics & Dynamics	5
	CE 310, Strength of Materials or ME 311, Mechanics of Materials	4

126.5 credits

Suggested Schedule B.S. Engineering Physics, Aerospace Systems

(A)=aircraft track, (S)=spacecraft track

Fall Semester

Spring Semester

Freshman Year

AE 245 , Intro To Aerospace Engineering	3	C&PE 121 , Intro. Comp. in Engr., or EECS 138, Intro To Computing	3
CHEM 184, Found. Chemistry I, or CHEM 150, Chem. For Engineers	5	ENGL 102, Critical Reading & Writing	3
ENGL 101, Composition	3	MATH 122, Calculus II	5
MATH 121, Calculus I	5	PHSX 211/213, General Physics I	4
PHSX 150 , Seminar Phsx, Astr, Ephx	0.5		
	16.5		15

Sophomore Year

AE 345, Fluid Mechanics	3	AE 445 , Aircraft Aerodyn. & Perform.	3
CE 301, Statics & Dynamics	5	C&PE 221 , Basic Engr. Thermodyn. or ME 312, Basic Engr. Thermodyn.	3
PHSX 212/214 , General Physics II	4	CE 310, Strength of Materials	4
MATH 223, Vector Calculus	3	MATH 220/320, Differential Equations	3
MATH 290, Linear Algebra	2	PHSX 313, General Physics III	3
		PHSX 316, Intermediate Physics Lab	1
	17		17

Junior Year

AE 507 , Aerospace Structures I	3	AE 421 , Aero. Computer Graphics	4
AE 545 , Fund. Of Aerodyn.	5	AE 551 , Dynamics of Flight II	4
AE 550 , Dynamics of Flight I	3	AE 572 , Fund. Of Jet Propulsion	3
EPHX 521 , Mechanics I	3	AE 508 , Aerospace Structures II (A) or EPHX 536 , Elec. Circ. Ms&Dsn (S)	3 or 4
General Education	3		
	17		14-15

Senior Year

AE 521 , Aero. Sys. Design I (A) or AE 560 , Spacecraft Systems (S)	4 or 3	EPHX 536 , Elec. Circ. Ms & Dsgn (A) or AE 523 , Space Systems Design (S)	4
EPHX 516 , Physical Measurements	4	EPHX 601 , Dsgn. Phys. & Elect. Systems	4
EPHX 531 , Electricity & Magnetism	3	General Education	6
General Education	6		
	16-17		14

Courses that are only offered in semester listed are annotated in boldface type.

Bachelor of Science in Engineering Physics, Chemical Systems

General Education Requirements (26 credits)		Hours
English	ENGL 101 and ENGL 102	6
Chemistry	CHEM 184, Foundations of Chemistry	5
Engineering Gen. education requirements	Courses from approved list in topical areas of: economics, ethics, communication, environmental concern and contemporary issues (see page 31)	15

Core Physics (26.5 credits)		Hours
PHSX 150	Seminar in Physics, Astronomy and Engineering Physics	0.5
PHSX 211 or 213	General Physics I (213 is honors/majors equivalent)	4
PHSX 212 or 214	General Physics II (214 is honors/majors equivalent)	4
PHSX 313	General Physics III	3
PHSX 316	Intermediate Physics Laboratory (with or after PHSX 313)	1
EPHX 516	Physical Measurements	4
EPHX 521	Mechanics I	3
EPHX 531	Electricity & Magnetism	3
PHSX 601	Design of Physical & Electronic Systems	4

Mathematics (18 credits)		Hours
MATH 121	Calculus I	5
MATH 122	Calculus II	5
MATH 223	Vector Calculus	3
MATH 290	Elementary Linear Algebra	2
MATH 220 or 320	Applied or Elementary Differential Equations.	3

Requirements specific for this option: Design Option in Chemical Systems (57 credits)		Hours
Physics	EPHX 536, Electronic Circuit Measurement & Design	4
	EPHX 511, Intro Quantum Mechanics	3
Chemistry	CHEM 188, Foundations of Chemistry II	5
	CHEM 624, Organic Chemistry I	3
	CHEM 646, Physical Chemistry I	3
Chem & Petr.Eng	C&PE 121, Intro. to Computers in Engineering, or EECS 138, Intro. to Computing	3
	C&PE 211, Material & Energy Balances	3
	C&PE 221 or ME 312, Basic Engr. Thermodynamics	3
	C&PE 511, Momentum Transfer , or AE 345/ME 510 Fluid Mechanics	3
	C&PE 512, Process Engr. Thermodynamics	3
	C&PE 521 or ME 612, Heat Transfer	3
	C&PE 522, Economic Appraisal of Chemical & Petroleum Projects	2
	C&PE 523, Mass Transfer	4
	C&PE 524, Chemical Engineering Kinetics & Reactor Design	3
	C&PE 613, Chemical Engr. Design I	4
	C&PE 615, Intro. to Process Dynamics and Control	3
	C&PE 616, Chemical Engr. Lab I	3
	C&PE 623, Chemical Engr. Design II	2

127.5 credits

Suggested Schedule B.S. Engineering Physics, Chemical Systems

Fall Semester

Spring Semester

Freshman Year

General Education	3	CHEM 188 , <i>Found. Chemistry II</i>	5
CHEM 184 , <i>Found. Chemistry I</i>	5	ENGL 102, <i>Critical Reading & Writing</i>	3
ENGL 101, <i>Composition</i>	3	MATH 122, <i>Calculus II</i>	5
MATH 121, <i>Calculus I</i>	5	PHSX 211/213, <i>General Physics I</i>	4
PHSX 150 , <i>Seminar in Physics, Astronomy & Engineering Physics</i>	0.5		
	16.5		17

Sophomore Year

C&PE 211 , <i>Material & Energy Balances</i>	3	PHSX 313, <i>General Physics III</i>	3
PHSX 212/214 , <i>General Physics II</i>	4	PHSX 316, <i>Intermediate Physics Lab</i>	1
MATH 223, <i>Vector Calculus</i>	3	MATH 220/320, <i>Differential Equations</i>	3
MATH 290, <i>Linear Algebra</i>	2	CHEM 624, <i>Organic Chemistry I</i>	3
C&PE 121, <i>Intro to Comp. Engr.</i>	3	C&PE 221 , <i>Basic Engr. Thermodyn</i>	3
		General Education	3
	15		16

Junior Year

CHEM 646 , <i>Intro. To Physical Chemistry</i>	3	C&PE 521 , <i>Heat Transfer</i>	3
C&PE 511 , <i>Momentum Transfer</i>	3	C&PE 523 , <i>Mass Transfer</i>	4
C&PE 512 , <i>Proc. Engr. Thermo.</i>	3	C&PE 524 , <i>Kinetics & Reactor Design</i>	3
C&PE 522 , <i>Econ. Apprais. C&PE Proj.</i>	2	EPHX 536 , <i>Elec. Circ. Meas. & Dsgn</i>	4
EPHX 521 , <i>Mechanics I</i>	3	General Education	3
	14		17

Senior Year

EPHX 516 , <i>Physical Measurements</i>	4	EPHX 511 , <i>Intro. Quantum Mechanics</i>	3
EPHX 531 , <i>Electricity & Magnetism</i>	3	EPHX 601 , <i>Dsgn. Phys & Elect. Systems</i>	4
C&PE 613 , <i>Chem. Eng. Design I</i>	4	C&PE 623 , <i>Chem. Engr. Design II</i>	2
C&PE 615 , <i>Int. Proc. Dyn & Cnt.</i>	3	General Education	6
C&PE 616 , <i>Chem. Eng. Lab I.</i>	3		
	17		15

Courses that are only offered in semester listed are annotated in boldface type.

Bachelor of Science in Engineering Physics, Digital Electronic Systems

General Education Requirements (26 credits)		Hours
English	ENGL 101 and ENGL 102	6
Chemistry	CHEM 184, Foundations of Chemistry or CHEM 150, Chemistry for Engineers	5
Engineering Gen. education requirements	Courses from approved list in topical areas of: economics, ethics, communication, environmental concern and contemporary issues (see page 31)	15

Core Physics (26.5 credits)		Hours
PHSX 150	Seminar in Physics, Astronomy and Engineering Physics	0.5
PHSX 211 or 213	General Physics I (213 is honors/majors equivalent)	4
PHSX 212 or 214	General Physics II (214 is honors/majors equivalent)	4
PHSX 313	General Physics III	3
PHSX 316	Intermediate Physics Laboratory (with or after PHSX 313)	1
EPHX 516	Physical Measurements	4
EPHX 521	Mechanics I	3
EPHX 531	Electricity & Magnetism	3
PHSX 601	Design of Physical & Electronic Systems	4

Mathematics (18 credits)		Hours
MATH 121	Calculus I	5
MATH 122	Calculus II	5
MATH 223	Vector Calculus	3
MATH 290	Elementary Linear Algebra	2
MATH 220 or 320	Applied or Elementary Differential Equations	3

Requirements specific for Design Option in Digital Electronic Systems (58 credits)		Hours
Physics	EPHX 511, Intro Quantum Mechanics	3
Elect. Engr & Computer Sci.	EECS 140, Intro to Digital Logic Design (or EECS 141, honors)	4
	EECS 168, Programming I	4
	EECS 211, Circuits I	3
	EECS 212, Circuits II	4
	EECS 268, Programming II	4
	EECS 312, Electronic Circuits I.	3
	EECS 360, Signal and System Analysis	4
	EECS 388, Computer Systems & Assembly Language	4
	EECS 443, Digital Systems Design	4
	EECS 448, Software Engineering I	3
	EECS 461, Probability & Statistics	3
	EECS 470, Electronic Devices & Properties of Materials	3
	EECS 541, Computer Systems Design Lab I	3
	EECS 542, Computer Systems Design Lab II	3
	EECS 645 Computer Architecture or 643, Advanced Computer Architecture	3
	Elective: Allowed courses have been EECS 546, 644,670,690,713 as well as 672 and 678	3

128.5 credits

Suggested Schedule B.S. Engineering Physics, Digital Electronic Systems

Fall Semester

Spring Semester

Freshman Year

CHEM 184, <i>Found. Chemistry I</i> , or Chem 150 , <i>Chemistry for Engineers</i>	5	ENGL 102, <i>Critical Reading & Writing</i>	3
ENGL 101, <i>Composition</i>	3	MATH 122, <i>Calculus II</i>	5
MATH 121, <i>Calculus I</i>	5	PHSX 211/213, <i>General Physics I</i>	4
PHSX 150 , <i>Seminar in Physics, Astronomy & Engineering Physics</i>	0.5	EECS 168, <i>Programming I</i>	4
General Education	3		
	16.5		16

Sophomore Year

PHSX 212/214 , <i>General Physics II</i>	4	PHSX 313, <i>General Physics III</i>	3
MATH 220 or 320, <i>Differential Eqtns.</i>	3	PHSX 316, <i>Intermediate Physics Lab</i>	1
MATH 290, <i>Linear Algebra</i>	2	MATH 223, <i>Vector Calculus</i>	3
EECS 140, <i>Intro. To Digital Logical Dsgn</i>	4	EECS 212, <i>Circuits II</i>	4
EECS 211, <i>Circuits I</i>	3	EECS 268, <i>Programming II</i>	4
	16		15

Junior Year

EPHX 521 , <i>Mechanics I</i>	3	EPHX 511 , <i>Intro. Quantum Mechanics</i>	3
EECS 360, <i>Signal & System Analysis</i>	4	EECS 443 , <i>Digital Systems Design</i>	4
EECS 388, <i>Comp. Syst & Assemb. Lang.</i>	4	EECS 448, <i>Software Engineering</i>	3
EECS 312, <i>Electronic Circuits I</i>	3	EECS 461 , <i>Probability & Statistics</i>	3
General Education	3	General Education	3
	17		17

Senior Year

EPHX 516 , <i>Physical Measurements</i>	4	EECS 542 , <i>Comp. Syst. Design Lab II</i>	3
EPHX 531 , <i>Electricity & Magnetism</i>	3	EPHX 601 , <i>Dsgn. Phys & Elect. Systems</i>	4
EECS 470 , <i>Electronic Devices & Properties of Materials</i>	3	EECS 645, <i>Computer Architecture</i> , or EECS 643 , <i>Advanced Computer Organization</i>	3
EECS 541 , <i>Comp. Syst. Design Lab I</i>	3	General Education	6
EECS elective	3		
	16		16

Courses that are only offered in semester listed are annotated in boldface type.

Bachelor of Science in Engineering Physics, Electromechanical Control Systems

General Education Requirements (26 credits)		Hours
English	ENGL 101 and ENGL 102	6
Chemistry	CHEM 184, Foundations of Chemistry, or CHEM 150, Chemistry for Engineers	5
Engineering Gen. education requirements	Courses from approved list in topical areas of: economics, ethics, communication, environmental concern and contemporary issues (see page 31).	15

Core Physics (26.5 credits)		Hours
PHSX 150	Seminar in Physics, Astronomy and Engineering Physics	0.5
PHSX 211 or 213	General Physics I (213 is honors/majors equivalent)	4
PHSX 212 or 214	General Physics II (214 is honors/majors equivalent)	4
PHSX 313	General Physics III	3
PHSX 316	Intermediate Physics Laboratory (with or after PHSX 313)	1
EPHX 516	Physical Measurements	4
EPHX 521	Mechanics I	3
EPHX 531	Electricity & Magnetism	3
PHSX 601	Design of Physical & Electronic Systems	4

Mathematics (18 credits)		Hours
MATH 121	Calculus I	5
MATH 122	Calculus II	5
MATH 223	Vector Calculus	3
MATH 290	Elementary Linear Algebra	2
MATH 220 or 320	Applied or Elementary Differential Equations	3

Requirements specific for Design Option in Electromechanical Control Systems (57 credits)		Hours
Physics	EPHX 511, Intro Quantum Mechanics	3
Elect. Engr & Computer Sci.	EECS 140, Intro to Digital Logic Design (or EECS 141, honors)	4
	EECS 168, Programming I	4
	EECS 211, Circuits I	3
	EECS 212, Circuits II	4
	EECS 268, Programming II	4
	EECS 312, Electronic Circuits I.	3
	EECS 360, Signal and System Analysis	4
	EECS 444 or ME 682, Control Systems	3
Mechanical Engr.	ME 228, Computer Graphics or AE 421	3
	ME 311 (3-4 credits), Mechanics of Materials or CE 310 (4 credits), Strength of Materials	4
	ME 312 or C&PE 221, Basic Engr. Thermodynamics	3
	ME 501, Mechanical Engr. Design Process	3
	ME 528, Mechanical Design I.	3
	ME 642 or 643, Design Project B or C (see notes below for engineering elective)	3
	ME 708, Microcomputer Applications in ME	3
	Additional engineering elective; ME 642, Design Project B – Formula Car , requires ME 627 to be taken in the previous semester as the engineering elective. ME 643 (Design Project C – Biomechanics) requires ME 633 to be taken in the previous semester as the engineering elective. ME 641 (Design Project A) is also available, but has several pre-requisite courses that would need to be taken.	3

127.5 credits

Suggested Schedule B.S. Engineering Physics, Electromechanical Control Systems

Fall Semester

Spring Semester

Freshman Year

CHEM 184 , <i>Found. Chemistry I</i> , or CHEM 150 , <i>Chemistry for Engineers</i>	5	ENGL 102, <i>Critical Reading & Writing</i>	3
ENGL 101, <i>Composition</i>	3	MATH 122, <i>Calculus II</i>	5
MATH 121, <i>Calculus I</i>	5	PHSX 211/213, <i>General Physics I</i>	4
PHSX 150 , <i>Seminar in Physics, Astronomy & Engineering Physics</i>	0.5	EECS 168, <i>Programming I</i>	4
ME 228 , <i>Computer Graphics</i>	3		
	16.5		16

Sophomore Year

PHSX 212/214, <i>General Physics II</i>	4	PHSX 313, <i>General Physics III</i>	3
MATH 220 or 320, <i>Differential Eqtns.</i>	3	PHSX 316, <i>Intermediate Physics Lab</i>	1
MATH 290, <i>Linear Algebra</i>	2	MATH 223, <i>Vector Calculus</i>	3
EECS 140, <i>Intro. To Digital Logical Dsgn</i>	4	EECS 212, <i>Circuits II</i>	4
EECS 211, <i>Circuits I</i>	3	EECS 268, <i>Programming II</i>	4
	16		15

Junior Year

EPHX 521 , <i>Mechanics I</i>	3	EPHX 511 , <i>Intro. Quantum Mechanics</i>	3
EECS 360, <i>Signal & System Analysis</i>	4	EECS 312, <i>Electronic Circuits I</i>	3
ME 311, <i>Mechanics of Materials</i> , or CE 310, <i>Strength of Materials</i>	3-4	ME 501 , <i>Mech. Eng. Design Process</i>	3
ME 312, <i>Basic Engr. Thermo.</i>	3	ME 528 , <i>Mechanical Design I</i>	3
General Education	3	General Education	3
	16-17		15

Senior Year

EPHX 516 , <i>Physical Measurements</i>	4	EPHX 601 , <i>Dsgn. Phys & Elect. Systems</i>	4
EPHX 531 , <i>Electricity & Magnetism</i>	3	ME 642 or 643 , <i>Design Project B or C</i>	3
ME 708 , <i>Microcomp. Appl. in Mechanical Engineering</i>	3	EECS 444 , <i>Control Systems or ME 682, Control Systems (FALL ONLY)</i>	3
Engineering Elective	3	General Education	6
General Education	3		
	16		16

Courses that are only offered in semester listed are annotated in boldface type.

General Education Component Electives for Engineering Physics Students.

A minimum of 3 credits from each of the five groups is required.

ECONOMICS Elective

ECON 104 Introductory Economics (4)
ECON 105 Introductory Economics, Honors (4)
ECON 142 Principles of Microeconomics (3)
ECON 143 Principles of Microeconomics Honors (3)
ECON 144 Principles of Macroeconomics (3)
ECON 145 Principles of Macroeconomics Honors (3)

ETHICS Elective

PHIL 160 Introduction to Ethics (3)
PHIL 161 Introduction to Ethics, Honors (3)
PHIL 180 Intro. to Social and Political Philosophy (3)
PHIL 181 Intro. to Social & Political Philosophy, Hnrs (3)
PHIL 360 Moral Issues in Business (3)
PHIL 375 Moral Issues in Computer Technology (3)
PHIL 380 Environmental Ethics (3)

COMMUNICATION Elective

COMS 130 Speaker-Audience Communications (3)
COMS 131 Speaker-Audience Communications Honors (3)
COMS 150 Personal Communication (3)
COMS 230 Fundamentals of Debate (3)
ENGR 504 Technical Writing for Engineers (1-3)
ENGR 515 Verbal Communications in Engineering (1)
ENGL 359 Grammar and Usage for Composition (3)
ENGL 360 Advanced Composition (3)
ENGL 362 Professional Writing (3)
ENGL 385 The Development of Modern English (3)
PHIL 148 Reason and Argument (3)

ENVIRONMENTAL CONCERN Elective

ATMO 525 Air Pollution Metrology (3)
BIOL 414 Principles of Ecology (3)
EVRN 320 Environmental Policy (3) (has pre-requisites)
GEOG 304 Environmental Conservation (3)
GEOL 302 Oceanography (3)
GEOL 351 Environmental Geology (3)
CE 477 Intro. to Environmental Engineering & Science (3)

CONTEMPORARY ISSUES Elective

AAAS 103 Introduction to Africa (3)
AM S 110 The American People (3)
AM S 112 The American People, Honors (3)
ANTH 100/SOC 110 General Anthropology (3-4)
ANTH 106/LING 106 Introductory Linguistics (3)
ANTH 107/LING 107 Honors Introductory Linguistics (3)
ANTH 108/ANTH 308 Intro. to Cultural Anthropology (3-4)
ANTH 109, Intro. to Cultural Anthropology, Honors (3-4)
ANTH 320/LING 320 Language in Culture & Society (3)
ANTH 321/LING 321 Language in Culture & Society, Honors (3)
COMS 310 Intro. to Organizational Communication (pre-requisites COMS 130 or 150) (3)
GEOG 100 World Regional Geography (3)
GEOG 102 Principles of Human Geography (3)
GEOG 103 Principles of Human Geography, Honors (3)
GEOG 591 Geography of Latin America (3)
LAA 100 Latin American Cultures and Society (3)
POLS 110 Introduction to U. S. Politics (3)
POLS 111 Introduction to U. S. Politics Honors (3)
POLS 150 Introduction to Comparative Politics (3)
POLS 151 Introduction to Comparative Politics, Honors (3)
POLS 170 Introduction to International Politics (3)
POLS 171 Introduction to International Politics, Honors (3)
POLS 310 Contemporary Issues in U.S. Politics (3)
POLS 350 Contemporary Issues in Comparative Politics (3)
POLS 370 Contemporary Issues in International Politics (3)
REES 110 Understanding Russia and East Europe (3)
REES 111 Honors Understanding Russia & East Europe (3)
SOC 104 Elements of Sociology (3)
SOC 105 Elements of Sociology, Honors (3)
SOC 110 American Identities (3)
SOC 112 American Identities, Honors (3)
SOC 220 Sociology of Families (3)
SOC 304 Principles of Sociology (3)
SOC 308 Principles of Family Sociology (3)
W S 201 Women's Studies: An Interdisciplinary Introduction (3)
W S 202 Women's Studies: An Interdisciplinary Introduction, Honors (3)

Minors in Physics & Astronomy

Requirements for the Minor

Minors in the College of Liberal Arts and Sciences are constructed with the following basic requirements: 18 hours in the minor field, with 12 of those hours required to be at a junior/senior level. The specific requirements for the physics minor and the astronomy minor follow:

The physics minor

PHSX 211 (or PHSX 213) General Physics I.....	4
PHSX 212 (or PHSX 214) General Physics II.....	4
PHSX 313 General Physics III	3
PHSX 316 Intermediate Physics Laboratory	1
PHSX 521 Mechanics I.....	3
PHSX 531 Electricity and Magnetism.....	3
Any PHSX course numbered 500 or above	3

21 credit hours, of which 13 are at the junior/senior level of work.

The astronomy minor

PHSX 211 (or PHSX 213) General Physics I.....	4
PHSX 212 (or PHSX 214) General Physics II.....	4
PHSX 313 General Physics III	3
PHSX 316 Intermediate Physics Laboratory	1
Astronomy and related field electives at the jr/sr level	8 or more

Students are strongly advised to take Astronomy 391 as their introductory course in astronomy; if students have already taken Astronomy 191 as an introductory astronomy course, they should inquire about taking 3 credit hours of Astronomy 390 instead. Be aware that Astronomy 591 and 592 are only taught in alternate years (Fall odd / Spring even) semesters.

The astrobiology minor

Preparatory coursework should include calculus (MATH 121 or 116, with 121 the preferred path) and CHEM 184.

Additional credits in astronomy, biology, chemistry, geology or physics (ABCGP) are required as follows:

- BIOL 150, Principles of Molecular and Cellular Biology (4)
- GEOL 101, Intro. to Geology, GEOL 105, History of the Earth, or GEOL 121, Prehistoric Life (3)
- ASTR 391, Physical Astronomy (3)
- ASTR 394, Extraterrestrial Life (3) or 3 credits of undergraduate research in astrobiology.
- 6 credits of coursework in ABCGP at the 300-level or higher and not in the student's major field

School of Business, concentration in physics

Students in the school of business may obtain a business degree with a concentration in physics as follows:

PHSX 211 (or PHSX 213) General Physics I.....	4
PHSX 212 (or PHSX 214) General Physics II.....	4
PHSX 313 General Physics III	3
PHSX 316 Intermediate Physics Laboratory	1
Junior/senior courses numbered 300 and above	11
for a total of 23 credits. Additional courses (18 credit hours) in mathematics are required:	
Math 121 or 141, Calculus I	5
Math 122 or 142, Calculus II	5
Math 223, Vector Calculus	3
Math 290, Linear Algebra	2
Math 320, Elementary Differential Equations	3

Planned Schedule of Courses

Courses Normally Offered Both Fall and Spring Semesters

Course Number and Title	Prerequisites
ASTR 191 Contemporary Astronomy	High School alg. and geom.
ASTR 196 Introductory Astronomy Laboratory	ASTR 191 or 391 (Co.)
ASTR 390 Undergraduate Problems	Permission
ASTR 503 Undergraduate Research	Permission
ASTR 597 Analysis in Astrophysics	ASTR 592 or ASTR 692
PHSX 111 Introductory Physics	Eligibility for MATH 104
PHSX 114 College Physics I	MATH 104
PHSX 115 College Physics II	PHSX 114
PHSX 116 Introductory Physics Lab	PHSX 111 (Co.)
PHSX 211 General Physics I	MATH 121 or 116
PHSX 212 General Physics II	PHSX 211, MATH 122 (Co.)
PHSX 213 General Physics I Honors	MATH 121 and permission
PHSX 313 General Physics III	PHSX 212/214 or EECS 220 MATH 220/320 (Co.)
PHSX 316 Intermediate Physics Laboratory	PHSX 313 (pre- or co-requisite)
PHSX 500 Special Problems	Permission, see catalog
PHSX/EPHX 501 Honors Research	Permission, see catalog
PHSX/EPHX 503 Undergraduate Research	Permission, see catalog
PHSX 700 Colloquium	None
PHSX/ASTR 791 Seminar in Astrophysics	Permission, see catalog
PHSX 800 Graduate Problems	Permission, see catalog
PHSX/ASTR 897 Seminar in Plasma and Space Physics	Permission, see catalog
PHSX 899 Master's Research/Thesis	Permission, see catalog
PHSX 917 Seminar in Theoretical Physics	Permission, see catalog
PHSX 947 Seminar in Nuclear Physics	Permission, see catalog
PHSX 967 Seminar in Particle Physics	Permission, see catalog
PHSX 987 Seminar in Solid State Physics	Permission, see catalog
PHSX 999 Ph.D. Dissertation Research	Permission, see catalog

Courses Normally Offered in Summer

Course Number and Title	Prerequisites
ASTR 390 Undergraduate Problems	Permission
ASTR 503 Undergraduate Research	Permission
ASTR 597 Analysis in Astrophysics	ASTR 592 or ASTR 692
PHSX 114 College Physics I	MATH 104
PHSX 115 College Physics II	PHSX 114
PHSX 211 General Physics I	
PHSX 500 Special Problems	Permission, see catalog
PHSX/EPHX 501 Honors Research	Permission, see catalog
PHSX/EPHX 503 Undergraduate Research	Permission, see catalog
PHSX 800 Graduate Problems	Permission, see catalog
PHSX 899 Master's Research/Thesis	Permission, see catalog
PHSX 999 Ph.D. Dissertation Research	Permission, see catalog

Courses Normally Offered Each Fall Semester

Course Number and Title	Prerequisites
PHSX 214 General Physics II Honors	PHSX 211/213, MATH 122 (Co.)
PHSX/EPHX 516 Physical Measurements	PHSX 313, 316, 521 (coreq)
PHSX/EPHX 521 Mechanics I	PHSX 211/213, MATH 223, 290, 220/320
PHSX/EPHX 531 Electricity & Magnetism	PHSX 212/214, MATH 223, 290, 220/320, PHSX 521/permis.
PHSX/EPHX 671 Thermal Physics	PHSX 611
PHSX 711 Quantum Mechanics I	PHSX 611, MATH 320
PHSX 717 Graduate Seminar	First year graduate student
PHSX/CHEM 718 Mathematical Methods in Physical Sciences	2 semesters jr.-sr. MATH
PHSX 821 Classical Mechanics	12 hrs jr.-sr. PHSX

Courses Normally Offered Each Spring Semester

Course Number and Title	Prerequisites
ASTR 391 Physical Astronomy	MATH 121 & honors or permission
ASTR 394 The Quest for Extraterrestrial Life	Intro GEOL, BIOL or ASTR course
PHSX/EPHX 511 Introductory Quantum Mechanics	PHSX 313, MATH 290
PHSX/EPHX 536 Electronic Circuits & Measurements	PHSX 212/214, MATH 223 and 290, PHSX 313 and 316 (rec.)
PHSX/EPHX 601 Design of Physical and Electronic Systems lab course	12 hrs jr./sr. PHSX/EPHX incl. one lab course
PHSX/EPHX 621 Mechanics II	PHSX 521
PHSX/EPHX 631 Electromagnetic Theory	PHSX 531
PHSX 811 Quantum Mechanics II	PHSX 711
PHSX/ASTR 815 Computational Physics & Astronomy	6 hrs jr.-sr. PHSX/ASTR
PHSX 831 Electrodynamics I	PHSX 718, PHSX 821

Courses Normally Offered Every Other Fall Semester

Course Number and Title	Prerequisites
ASTR 591 [†] Stellar Astronomy	PHSX 212
ASTR 596 [†] Observational Astrophysics	ASTR 591 pre- or co-req.
ASTR/PHSX/EPHX 691 [†] Astrophysics I	PHSX 313 or consent
PHSX/EPHX 661 [†] Introduction to Elementary Particle Physics	PHSX 313
PHSX 761 [†] Elementary Particles I	PHSX 711
PHSX 781 [†] Solid State Physics I	PHSX 611, 671
PHSX792+ Topics in Advanced Astrophysics	ASTR 692 or consent
PHSX 911 [†] Quantum Mechanics III	PHSX 811
PHSX 931 [†] Electrodynamics II	PHSX 831

Courses Normally Offered Every Other Spring Semester

Course Number and Title	Prerequisites
ASTR 592 [†] Galactic & Extragalactic Astronomy	ASTR 591 or consent
ASTR 692 ⁺ Astrophysics II	ASTR 691 or consent
PHSX/EPHX 641 [†] Introduction to Nuclear Physics	PHSX 313 and 611
PHSX/EPHX 693 [†] Gravitation & Cosmology	PHSX 313, MATH 320
PHSX731+ Molecular Biophysics	PHSX212, MATH 122 +CHEM188
PHSX 741 [†] Nuclear Physics I	PHSX 611
PHSX 793 [†] Physical Cosmology	MATH 718
PHSX/ASTR 795 ⁺ Space Plasma Physics	PHSX 621, 631 (coreq)
PHSX 871 [†] Statistical Physics I	PHSX 711, 821, 671 (rec.)

Courses Offered Occasionally

Course Number and Title	Prerequisites
ASTR 293 Astronomy Bizarre	Previous ASTR course
PHSX 112 Concepts in Physics, Honors	Eligible for MATH 104
PHSX 502 Seminar in Physics & Astronomy Instruction	Permission
PHSX/EPHX 518 Mathematical Physics	PHSX 313, MATH 320
PHSX 594 Cosmology and Culture	None
PHSX/EPHX 600 Special Topics in Physics and Astrophysics	Permission
PHSX/EPHX 615 Numerical and Computational Methods in Physics	PHSX 313, MATH 320, EECS 138
PHSX/EPHX 623 Physics of Fluids	MATH 223&290,PHSX 212/214
PHSX/EPHX 655 Optics	PHSX 313 and 316
PHSX/EPHX 681 Concepts in Solids	PHSX 313 and 611
PHSX 721 ⁺ Chaotic Dynamics	MATH 320, PHSX 521
PHSX 801 Advanced Topics	Permission
PHSX 841 Nuclear Physics II	PHSX 741, 811
PHSX 861 Elementary Particles II	PHSX 761, 911 (Coreq)
PHSX 881 Solid State Physics II	PHSX 631, 711
PHSX 895 Plasma Physics	PHSX 795
PHSX 912 Quantum Field Theory	PHSX 911
PHSX 915 Relativity	10 hrs. jr./sr. PHSX/MATH
PHSX 971 Advanced Statistical Mechanics	PHSX 871 or CHEM 917

Several courses cross-listed with Geology are not included.

⁺ These courses are taught in odd-numbered years.

[†] These courses are taught in even-numbered years.

Course Numbering System

- Courses 000–099** do not count toward graduation.
- Courses 100–299** are designed for freshman and sophomores.
- Courses 300–499** are designed for juniors and seniors.
- Courses 500–699** are designed primarily for juniors and seniors but may be taken by graduate students for graduate credit.
- Courses 700–799** are designed primarily for graduate students who have less than 30 hours of graduate credit but may be taken by undergraduates for undergraduate credit.
- Courses 800–999** are open only to graduate students except by special permission.

NOTE: There are no sublevels within these six categories; *e.g.*, a 600–level course is not necessarily more advanced than a 500–level course. See the University Timetable of Classes and the Bulletin of the Graduate School for a complete description.

Research and Graduate Programs

The Department offers graduate work leading to the Masters and Ph.D. degrees in Physics. It has ongoing experimental and theoretical programs of research in astrophysics, biophysics, chaos, condensed matter, cosmology, elementary particles, nuclear physics, and plasma and space physics. The directory, beginning on page 1, lists the faculty interests in these areas and their sub-field. These endeavors provide occasional opportunities for capable undergraduate students to become involved in research.