FOR FURTHER INFORMATION

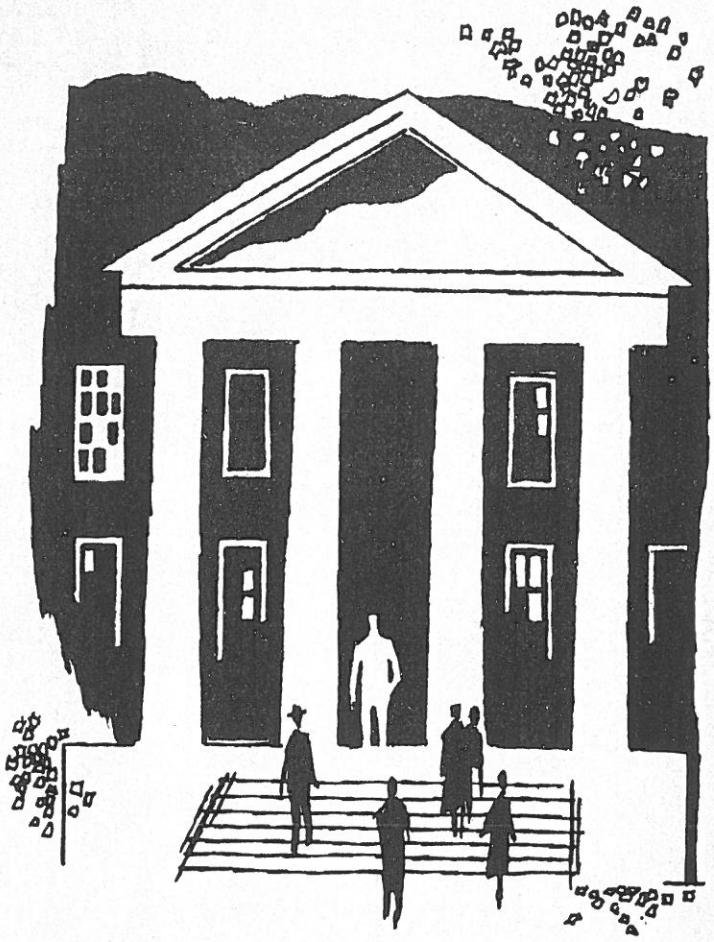
INFORMATION FOR PROSPECTIVE STUDENTS. This small booklet gives condensed general information concerning University colleges, schools, and other units. Also included: information on admission, fees, scholarships, student aid, housing, and student personnel services.

DESCRIPTIVE BOOKLETS. These booklets are available in the following fields: Botany, Business Administration, Dental Hygiene, Engineering, Engineering-Liberal Arts, Financial Aids, Fine Arts, Home Economics, Hospital Administration, Humanities, Journalism, Languages, Liberal Arts, Medical Technology, Mortuary Science (pre-), Museum Training, Nursing, Pharmacy, Physical Therapy, Physical Education (Men), Physical Education (Women), Sciences, Social Work, Speech, Dramatic Arts and Television, and "Your Home at SUI".

CATALOGUE SECTION REPRINTS. Sections of the General University Catalogue (similar to this booklet) pertaining to the following areas of study are available in reprint form: Colleges—Business Administration, Dentistry, Education, Engineering, Graduate, Law, Liberal Arts, Medicine, Nursing, and Pharmacy. Schools and Departments—American Civilization, Art, Botany, Chemistry, Child Welfare, English, European Literature and Thought, Geography and Geology, History, Home Economics, Journalism, Languages, Mathematics, Music, Oriental Studies, Philosophy, Physical Education (Men), Physical Education (Women), Physics and Astronomy, Political Science, Psychology, Religion, Social Work, Sociology and Anthropology, Speech, Dramatic Art and Television, Speech Pathology and Audiology, Zoology, and Health Services.

TO OBTAIN INFORMATION on any of the above fields or application forms for admission, write to the Director of Admissions, University Hall, State University of Iowa, Iowa City.

FOR INFORMATION about married student or dormitory housing and application forms, write to the Dormitory Assignment Office, University Hall, State University of Iowa, Iowa City. For information about off-campus housing, scholarships, loans, and student employment, write to the Office of Student Affairs, University Hall, State University of Iowa, Iowa City.



Physics and Astronomy

STATE UNIVERSITY OF IOWA

Iowa City, Iowa

CALENDAR

FIRST SEMESTER 1960-61

September 6, Tuesday—Last date for applications for admission or transfer

September 16, Friday—Reporting date for new undergraduates who have not completed the Placement Tests, 1:00 p.m.

September 18, Sunday—Orientation for all new undergraduates, 7:30 p.m.

September 19, Monday—Beginning of registration

September 22, Thursday—Opening of classes, 7:30 a.m.; University Induction Ceremony, 9:25 a.m.

October 21 and 22, Friday and Saturday—Homecoming; classes suspended Friday, 12:20 p.m.

November 23, Wednesday—Beginning of Thanksgiving recess, 12:20 p.m.

November 24, Thursday—University Holiday, offices closed

November 28, Monday—Resumption of classes, 7:30 a.m.

December 16, Friday—Beginning of Holiday recess, 5:30 p.m.

December 23 and 26, Friday and Monday—University Holiday, offices closed

January 2, Monday—University Holiday, offices closed

January 3, Tuesday—Resumption of classes, 7:30 a.m.

January 27, Friday—Beginning of Examination Week, 8:00 a.m.

February 3, Friday—Close of First Semester classes, 5:30 p.m.

February 4, Saturday—University Commencement, 10:00 a.m.

SECOND SEMESTER 1960-61

January 26, Thursday—Last date for applications of admission or transfer

February 6, Monday—Beginning of registration, 8:00 a.m.

February 8, Wednesday—Opening of classes, 7:30 a.m.

February 25, Saturday—Foundation Day

March 30, Thursday—Beginning of Easter recess, 12:20 p.m.

April 4, Tuesday—Resumption of classes, 7:30 a.m.

May 30, Tuesday—University Holiday, offices closed

May 31, Wednesday—Beginning of Examination Week, 8:00 a.m.

June 7, Wednesday—Close of Second Semester classes, 5:30 p.m.

June 9, Friday—University Commencement, 9:30 a.m.

June 10, Saturday—Alumni Day

SUMMER SESSION 1961

June 2, Friday—Last date of applications for admission or transfer

June 12, Monday—Orientation for new undergraduate students

June 13, Tuesday—Registration for eight-week session, 9:00 a.m.

June 14, Wednesday—Opening of classes, 7:00 a.m.

July 4, Tuesday—University Holiday, offices closed

August 9, Wednesday—Close of Summer Session classes, 5:00 p.m.; University Commencement, 7:30 p.m.

August 10, Thursday—Opening of Independent Study Unit for Law and Graduate students

September 4, Monday—University Holiday, offices closed

September 6, Wednesday—Close of Independent Study Unit

FIRST SEMESTER 1961-62

September 5, Tuesday—Last date for applications for admission or transfer

September 15, Friday—Reporting dates for new undergraduates who have not completed the Placement Tests, 1:00 p.m.

September 17, Sunday—Orientation for all new undergraduates, 7:30 p.m.

September 18, Monday—Beginning of registration

September 21, Thursday—Opening of classes, 7:30 a.m.; University Induction Ceremony, 9:25 a.m.

October 20 and 21, Friday and Saturday—Homecoming; classes suspended Friday, 12:20 p.m.

PHYSICS

AND ASTRONOMY

Head of Department, James A. Van Allen
Office, 108 Physics Building

The Department of Physics and Astronomy aims to provide opportunity for comprehensive study of all basic aspects of these subjects and for individual scholarly work at an advanced level.

Career Opportunities

Persons possessing a mastery of physics and astronomy are in great demand as teachers in universities and colleges and as research workers in government and industrial laboratories. Those with a good working knowledge of these subjects at the B.A. level find many opportunities in high school teaching and in a variety of administrative and technical pursuits.

Undergraduate Major in Physics

The following courses or their equivalents are required for the Bachelor of Arts degree with a major in physics:

29:1, 2	College Physics or
29:7, 8	General Physics
29:3	College Physics (Atomic and Nuclear)
22:4	College Algebra and Trigonometry
22:5	Analytic Geometry
22:6, 7	Calculus
22:103	Elementary Theoretical Mechanics (formerly 22:139 or 29:139)
29:129, 130	Electricity and Magnetism
4:1	General Chemistry

and 6 additional semester hours of physics and mathematics chosen from the following:

22:104	Elementary Theoretical Mechanics (formerly 22:140 or 29:140)
22:105	Advanced Calculus
29:117	Optics
29:118	Heat and Thermodynamics
29:133, 134	Atomic and Nuclear Physics Laboratory
29:205	Classical Mechanics (formerly 29:152)
29:171, 172	Methods of Theoretical Physics
29:191, 192	Modern Physics

Undergraduate majors who plan to pursue graduate study in physics are advised:

(a) to take 29:171, 172 Methods of Theoretical Physics during their junior or senior year,

(b) to acquire reading facility in either Russian or German, and

(c) to go beyond the minimum requirements listed above to the greatest feasible extent.

Honors Work in Elementary Physics 29:5, 6 is available for undergraduates of high aptitude and interest. Selected junior and senior majors take up to 8 semester hours of Honors Seminar 29:99 as part of their program for the degree Bachelor of Arts with Honors.

For the general requirements of the College of Liberal Arts, see *College of Liberal Arts*.

Undergraduate Major in Astronomy

The following courses or their equivalents are required for the Bachelor of Arts degree with a major in astronomy:

29:1, 2	College Physics or
29:7, 8	General Physics
4:1	General Chemistry
29:3	College Physics (Atomic and Nuclear)
22:4	College Algebra and Trigonometry
22:5	Analytic Geometry
22:6, 7	Calculus
29:61, 62	General Astronomy
22:103, 104	Elementary Theoretical Mechanics (formerly 22:139, 140 or 29:139, 140)
29:119	Practical Astronomy
29:148	Astrophysics

and 6 additional semester hours in astronomy, physics, and mathematics chosen from the following:

22:101	Differential Equations (formerly 22:141)
29:117	Optics
29:129, 130	Electricity and Magnetism
29:185	Celestial Mechanics

Undergraduates majoring in astronomy are advised to take at least an introductory course in Russian or German and if possible to continue until they have acquired facility in reading that language.

Graduate Program

Two advanced degrees are offered in physics, the Master of Science (with or without thesis) and the Doctor of Philosophy, and one in astronomy, the Master of Science (with or without thesis).

Each entering graduate student is assigned to a faculty adviser who will assist him in preparing a plan of study and in guiding his progress. A graduate student becomes a candidate for an advanced degree in physics or astronomy only after he has passed a general examination in all principal areas of the subject at the level of advanced undergraduate work. The examination is ordinarily given in March of each year and must be taken by all first-year graduate students. Ordinarily, a candidate for an advanced degree should begin research in his chosen specialty during his second year of residency. His thesis or essay adviser then becomes his general adviser and the chairman of his final examination committee.

For the general requirements for admission to the Graduate College and for advanced degrees, see *Graduate College*.

Master of Science Degree in Physics

The Master of Science degree is offered with thesis or without thesis. Either degree may be an intermediate step toward a Ph.D. degree, or it may be a terminal degree. The final examination in

either case is an oral one by a faculty committee appointed by the Dean of the Graduate College.

The program for the M.S. degree with thesis requires at least 24 semester hours of graduate course work and a thesis based on an original experimental or theoretical investigation by the candidate.

The program for the M.S. degree without thesis comprises a somewhat broader program of study (total of 38 semester hours of graduate work), an independent study of the literature on a chosen topic, and the preparation of a critical essay on that topic (for which a maximum of 4 semester hours of credit is allowed). Up to one-third of the graduate program may be in related scientific fields other than physics and mathematics, e.g., chemistry, astronomy, engineering, etc.

The candidate for either of the M.S. degrees must have completed satisfactorily at least the following courses or their equivalents as an undergraduate or a graduate, either at this university or elsewhere:

22:101	Differential Equations
29:117	Optics
29:118	Heat and Thermodynamics
22:103, 104	Elementary Theoretical Mechanics
22:105	Advanced Calculus
29:129, 130	Electricity and Magnetism
29:133, 134	Atomic and Nuclear Physics Laboratory
29:191, 192	Modern Physics

His plan of study should provide for as much advanced work as his aptitude and previous preparation permit. If he expects to continue toward a Ph.D. degree, he should take 29:171, 172 during his first year of residency. Study of scientific Russian or German is recommended but is not required of M.S. candidates.

Master of Science Degree in Astronomy

The Master of Science degree is offered with or without thesis. The general nature of the program of study for either degree is similar to that for the corresponding M.S. degree in physics (q.v.).

Specific departmental requirements for the M.S. degree in astronomy are:

The substantial equivalent of the undergraduate major program in astronomy listed in an earlier paragraph, and as many of the following courses as feasible:

29:146	Interstellar Matter
29:147	Galactic Structure
29:171, 172	Methods of Theoretical Physics
29:191, 192	Modern Physics
22:115	Numerical Methods in Mathematics
22:116	Numerical Solution of Differential Equations
29:205	Classical Mechanics
29:273	Relativity
29:278	Solar-Terrestrial Physics
29:290	Physics and Chemistry of the Upper Atmosphere

An individual plan of study must be worked out by each candidate early in his graduate study.

Doctor of Philosophy Degree in Physics

The program of study for the Ph.D. degree with major in physics includes:

(1) Thorough course work in both classical and modern theoretical physics for all candidates, whether their specialized research is to be in an experimental or a theoretical area.

(2) Comprehensive examinations.

(3) Participation in advanced seminars and

(4) Successful conduct of a major original research in either experimental or theoretical physics and the preparation and defense of a written dissertation based on this work.

Emphasis is laid on the capabilities developed and the knowledge gained rather than on the particular courses taken, credits acquired, or other aspects of the means to the end. Although no specific courses are required, the following are recommended as preparation for the comprehensive examinations: Classical Mechanics 29:205; the classical theoretical physics sequence 29:211, 29:212, 29:213 and 29:214; Quantum Mechanics 29:247, 248; Nuclear Physics 29:249, 250; and Relativity 29:273.

Advanced mathematics such as the theory of functions of a complex variable and vector and tensor analysis are used freely in these courses. An introduction to these fields is given in Methods of Theoretical Physics 29:171, 172. The selection of less advanced courses will depend on the adequacy of the student's preparation for graduate work; his choice of more advanced and specialized courses will depend on the direction in which his interests develop.

Before a candidate is admitted to the comprehensive examinations he must acquire and demonstrate to the appropriate foreign language department the ability to read papers on physics in German and in one of the following three other languages—Russian, French, and Italian.

Each candidate must present and defend an original proposition of a research or speculative nature as a part of his comprehensive examinations.

A candidate for the Ph.D. degree will not be recommended for the degree until he has written his dissertation in proper form for formal publication and has submitted it, with the approval of his research adviser, for publication to a standard scientific journal of wide distribution.

Research

The department has an excellent library and a number of well-equipped laboratories. The central machine shop is fully equipped and staffed with skilled instrument makers and machinists, and there are several electronics and machine shops for the use of advanced students and the research staff. A twelve and one-half inch Cassegranian-Newtonian telescope is located at an outlying site.

The greater part of the experimental research in the department is in low-energy nuclear physics, cosmic rays, atmospheric physics, space physics, and astrophysics.

Theoretical research is devoted to atomic and nuclear theory, quantum field theory, and solar-terrestrial physics.

Persons qualified for graduate study are invited to apply for fellowships and assistantships. Inquiries should be directed to the departmental office.

STAFF

Professors James A. Jacobs, Josef M. Jauch,* E. P. T. Tyndall, James A. Van Allen.

Professors Emeritii: John A. Eldridge,* Charles C. Wylie.*

Associate Professors: Stanley Bashkin,* Richard R. Carlson,* Fritz Coester, Edward B. Nelson, Fritz Rohrlich.

Assistant Professors: Francis T. Cole,* Brian J. O'Brien, Ernest C. Ray, David Speiser.

Instructors: Anthony C. L. Barnard, Jack Cohn.

Full-Time Research Associates and Assistants: David M. Kaplan, Carl E. McIlwain, Guido Pizzela, Pamela Rothwell, Sekiko Yoshida.

National Science Foundation Fellow: David L. Dittmer.

U. S. Steel Foundation Fellow: George H. Ludwig.

Woodrow Wilson Fellow: Jerome R. Redus.

Graduate Research and Teaching Assistants: Mr. John E. Bergeson, Mr. Edward H. Berkowitz, Mr. Jerome S. Butts, Mr. Dale L. Chinburg, Mr. Raymond H. Cyr, Mr. Wayne B. Day, Mr. John W. Freeman, Mr. Harvey E. Groskreutz, Mr. Gary L. Hockey, Mr. Duane F. Ingram, Mr. Richard Jann, Mr. Chong Chol Kim, Mr. Curtis D. Laughlin, Mr. Joseph D. Lenguadoro, Miss Chyong Lin, Mrs. Hsey-Er Lin, Mr. Wei Ching Lin, Mr. Robert H. Lynch, Mr. Lalit K. Pande, Mr. Paul E. Peterson, Mr. Herbert H. Sauer, Mr. Larry D. Schlenker, Mr. Donald E. Simanek, Mr. Daniel R. Smith, Mr. Joseph C. Stoltzfus, Mr. Ernest A. Thieleker, Mr. James D. Thissel, Mr. John I. Valerio, Mr. John R. Zink.

Librarian: Mr. Gerald M. Stevenson.

*On leave of absence 1959-60.

COURSE DESCRIPTIONS

Physics

Primarily for Undergraduates

29:1 College Physics — *4 s.h.*

Open to freshmen. Descriptive lectures and laboratory work in elementary physics. Mechanics, heat, and sound. Prerequisite, at least one year of work each in high school algebra and geometry. First semester. Instructor: Nelson.

29:2 College Physics — *4 s.h.*

Electricity, magnetism, and light. A continuation of 29:1, which is prerequisite. Second semester. Instructor: Nelson.

29:3 College Physics (Atomic and Nuclear) — *3 s.h.*

A continuation of 29:2 devoted to electronic, atomic, and nuclear phenomena. Emphasis on experimental rather than mathematical aspects. Of interest to all who wish an introduction to more recent developments in the subject. Prerequisites, 29:1 and 29:2 or 29:7 and 29:8. Instructor: Speiser.

29:5 Honors Work in Elementary Physics — *2 s.h.*

Enrollment limited to top-ranking students in 29:1 and 29:7. Discussion sessions with active participation by individual students. Instructor: Tyndall.

29:6 Honors Work in Elementary Physics — *2 s.h.*

Enrollment limited to top-ranking students in 29:2 and 29:8. Instructor: Tyndall.

29:7 General Physics — *5 s.h.*

Mechanics, wave motion, sound, and heat. Four recitation meetings and one two-hour laboratory each week. Prerequisite or corequisite, Mathematics 22:6. Required of all students in engineering. Open to others who have prerequisite mathematics. Both semesters. Instructor: Cohn.

29:8 General Physics — *5 s.h.*

Electricity, magnetism, and light. Continuation of 29:7, which is prerequisite. Both semesters. Instructor: Tyndall.

29:93 Reading in Physics — *cr.arr.*

Consult head of department before registering. Staff.

29:99 Honors Seminar — *1 or 2 s.h.*

For junior and senior Honor candidates majoring in physics. Guidance in conducting original scholarly investigations. May be repeated. Instructor: Jacobs.

For Undergraduates and Graduates

(These courses presuppose a working knowledge of differential and integral calculus and completion of 29:1 and 29:2 or 29:7 and 29:8.)

29:103 Reading in Physics — *cr.arr.*

Consult head of department before registering. Staff.

29:117 Optics *4 s.h.*

An introductory course in geometrical and physical optics. Lectures and laboratory exercises on the properties of lenses and simple optical instruments, and the phenomena of interference, diffraction and polarization. Three recitations and one laboratory period. Instructor: Tyndall.

29:118 Heat and Thermodynamics *3 s.h.*

Macroscopic description of thermal phenomena. The fundamental laws of thermodynamics and their applications.

29:126 Electrical Measurements *3 s.h.*

For electrical engineering students. One lecture, one laboratory, and one report each week. Second semester.

29:128 Electronics *3 s.h.*

Characteristics of vacuum tubes and transistors and their uses in electronic circuits. First semester. Instructor: O'Brien.

29:129 Electricity and Magnetism *4 s.h.*

Fundamental principles including the phenomenological foundations of Maxwell's equations and their applications. Three lectures and one laboratory. Instructor: Van Allen.

29:130 Electricity and Magnetism *4 s.h.*

Continuation of 29:129, which is prerequisite. Three lectures and one laboratory. Instructor: Van Allen.

29:133 Atomic and Nuclear Physics Laboratory *2 s.h.*

Advanced laboratory study of fundamental atomic constants, radioactivity, X-rays, optical spectroscopy, and cosmic rays. One laboratory period each week. Prerequisites, 29:3 and 29:129. First semester. Instructor: Barnard.

29:134 Atomic and Nuclear Physics Laboratory *2 s.h.*

Second semester. 29:133 is not prerequisite. Instructor: Barnard.

29:135 Atomic Physics *2 s.h.*

Brief introduction to atomic structure and nuclear phenomena, primarily for students in engineering; open to others by permission. (See 29:3.) Second semester. Instructor: Tyndall.

29:171 Methods of Theoretical Physics *3 s.h.*

Vector and tensor analysis, linear algebra, theory of analytic functions of a complex variable and other mathematical developments used in theoretical physics. Instructor: Coester.

29:172 Methods of Theoretical Physics *3 s.h.*

Continuation of 29:171. Instructor: Coester.

29:191 Modern Physics *3 s.h.*

Systematic development of present concepts of relativity, atomic and nuclear physics. Emphasis on physical principles rather than formal mathematical theory. Prerequisite, senior standing in physics or equivalent. Instructor: O'Brien.

29:192 Modern Physics *3 s.h.*

Continuation of 29:191. Instructor: O'Brien.

Primarily for Graduates

29:205 Classical Mechanics *3 s.h.*

(Formerly 29:152) Dynamics of mass points. A brief review of Lagrange's and Hamilton's equations. Canonical transformations and Hamilton-Jacobi theory. Topological methods and instability

theory after Poincaré and Liapounoff. Applications include various topics in celestial mechanics. Prerequisites, Mathematics 22:103, 104. Instructor: Ray.

29:211 Classical Theoretical Physics I, Mechanics of Continua *3 s.h.*

Hydrostatics, dynamics of ideal fluids, both incompressible and compressible; viscous flow; the classical theory of elasticity. Prerequisites, Mathematics 22:103, 104 and 29:171, 172 or the equivalent. Given in 1959-60 and alternate years thereafter. Instructor: Coester.

29:212 Classical Theoretical Physics II, Kinetic Theory and Statistical Mechanics *3 s.h.*

Elementary kinetic theory of ideal and non-ideal gases. General principles of classical and quantum statistical mechanics. Systems of identical particles. Applications. Prerequisites, 29:118, Mathematics 22:103, 104, and 29:171, 172, or the equivalent. Given in 1960-61 and alternate years thereafter. Instructor: Ray.

29:213 Classical Theoretical Physics III, Electromagnetic Theory *3 s.h.*

Basic principles of electrodynamics. Derivation of the phenomena from Maxwell's equations. Maxwell's theory for moving bodies. Prerequisites, 29:129, 130 and 29:171, 172 or the equivalent. Given in 1960-61 and alternate years thereafter. Instructor: Coester.

29:214 Classical Theoretical Physics IV, Optics and Electron Theory *3 s.h.*

Geometrical and wave optics. Interference and polarization of light. Theory of diffraction. Crystal optics. Emission and absorption of radiation. Electron theory of optical properties. Prerequisites, 29:129, 130 and 29:171, 172 or equivalent. Given in 1959-60 and alternate years thereafter. Instructor: Ray.

29:220 Individual Critical Study *cr.arr.*

An essay is to be written on a topic chosen in consultation with a member of the faculty. For candidates for the M.S. degree without thesis in physics or astronomy. Staff.

29:231 Atomic and Molecular Spectroscopy *3 s.h.*

Various aspects of theoretical and applied spectroscopy. Classification and interpretation of spectra. Prerequisites, 29:191, 192 and 29:247. Instructor: Rohrlich.

29:247 Quantum Mechanics *3 s.h.*

Non-relativistic wave mechanics of one and two particle systems. Prerequisites, 29:171, 172 and 29:191, 192. Instructor: Rohrlich.

29:248 Quantum Mechanics *3 s.h.*

Foundations of general quantum mechanics, and the quantum mechanics of many particle systems. Continuation of 29:247, which is prerequisite. Instructor: Rohrlich.

29:249 Nuclear Physics *3 s.h.*

Advanced course in phenomena of nuclear physics and their interpretation. Prerequisites, 29:191, 192. Pre- or corequisite, 29:247. Instructor: Jacobs.

29:250 Nuclear Physics *3 s.h.*

Continuation of 29:249, which is prerequisite. Instructor: Jacobs.

29:261 Colloquium *no cr.*

One hour per week throughout year. Open to all.

29:265 Seminar: Theoretical Physics *cr.arr.*

Discussion of current research. Instructors: Coester, Rohrlich, Ray, and Speiser.

29:269 Theoretical Nuclear Physics *3 s.h.*

Nuclear forces, two body problems, nuclear models, electromagnetic properties of nuclei, theory of nuclear reactions, γ-decay, β-decay. Prerequisites, 29:249, 250.

29:270 Theoretical Nuclear Physics *2 s.h.*

Continuation of 29:269.

29:273 Relativity *3 s.h.*

Relativistic formulation of mechanics and electrodynamics; Einstein's theory of gravitation. Instructor: Rohrlich.

29:276 Special Topics in Quantum Mechanics *3 s.h.*

Selection of special topics in advanced quantum theory. The topics selected vary from year to year. May be repeated. Instructors: Coester, Rohrlich.

29:278 Solar-Terrestrial Physics *2 s.h.*

Phenomena in the solar atmosphere, corpuscular and electromagnetic radiations in interplanetary space, the geomagnetic field and interplanetary magnetic fields, magnetic storms, aurorae and the geomagnetically-trapped radiations. Instructors: Van Allen, Ray.

29:281 Research in Physics *cr.arr.*

Prerequisite, consent of head of department. May be continued for an indefinite number of semesters and in the summer. Staff.

29:290 Physics and Chemistry of the Upper Atmosphere *2 s.h.*

Continuous and molecular physics of neutral and ionized gases. Absorption of solar radiation in ionizing and dissociative effects in relation to ionosphere ozone layer and chemical processes in upper atmosphere. The air glow and aurora. Tides and winds in ionosphere and electric currents associated with daily magnetic variations and magnetic storms. Instructor: Ray.

COURSE DESCRIPTIONS

Astronomy

Primarily for Undergraduates

29:61 General Astronomy *4 s.h.*

Prerequisites, Mathematics 22:4, 5. The solar system, stars, galaxies, and practical astronomy. One laboratory per week for observational and problem work.

29:62 General Astronomy *4 s.h.*

Continuation of 29:61.

For Undergraduates and Graduates

29:119 Practical Astronomy *3 s.h.*

Prerequisites, Mathematics 22:7 and 29:2 or equivalent. Design and use of astronomical instruments. Visual observations. Astronomical photography and photometry. Observations with the 12-inch Cassegrain telescope. Computing.

29:146 Interstellar Matter *3 s.h.*

Prerequisites, Mathematics 22:7 and 29:2 or equivalent. Atoms and molecules in space; absorption and emission lines in spectra. Solid particles and continuous absorption. Organization of matter into

nebulae. Relation to stars and to interstellar particles and dust. Evolutionary problems.

29:147 Galactic Structure *3 s.h.*

Prerequisites, Mathematics 22:7 and 29:2 or equivalent. Comparison of our galaxy with extra-galactic systems; stellar populations and motions; interstellar matter; radio-frequency radiation; evolution of stellar systems. The solar system.

29:148 Astrophysics *3 s.h.*

Prerequisites, Mathematics 22:7 and 29:1, 2, 3. Basic problems and methods of astrophysics; radiation and spectra of stars; stellar atmospheres; solar phenomena; solar-terrestrial relationships.

29:185 Celestial Mechanics *3 s.h.*

Prerequisites, Mathematics 22:103, 104.

29:198 Reading in Astronomy *cr.arr.*

Consult head of department before registering. Staff.

29:220 Individual Critical Study *cr.arr.*

An essay to be written on a topic chosen in consultation with a member of the faculty. For candidates for the M.S. degree without thesis in physics or astronomy. Staff.

29:298 Research in Astronomy *cr.arr.*

Prerequisite, consent of head of department. Staff.