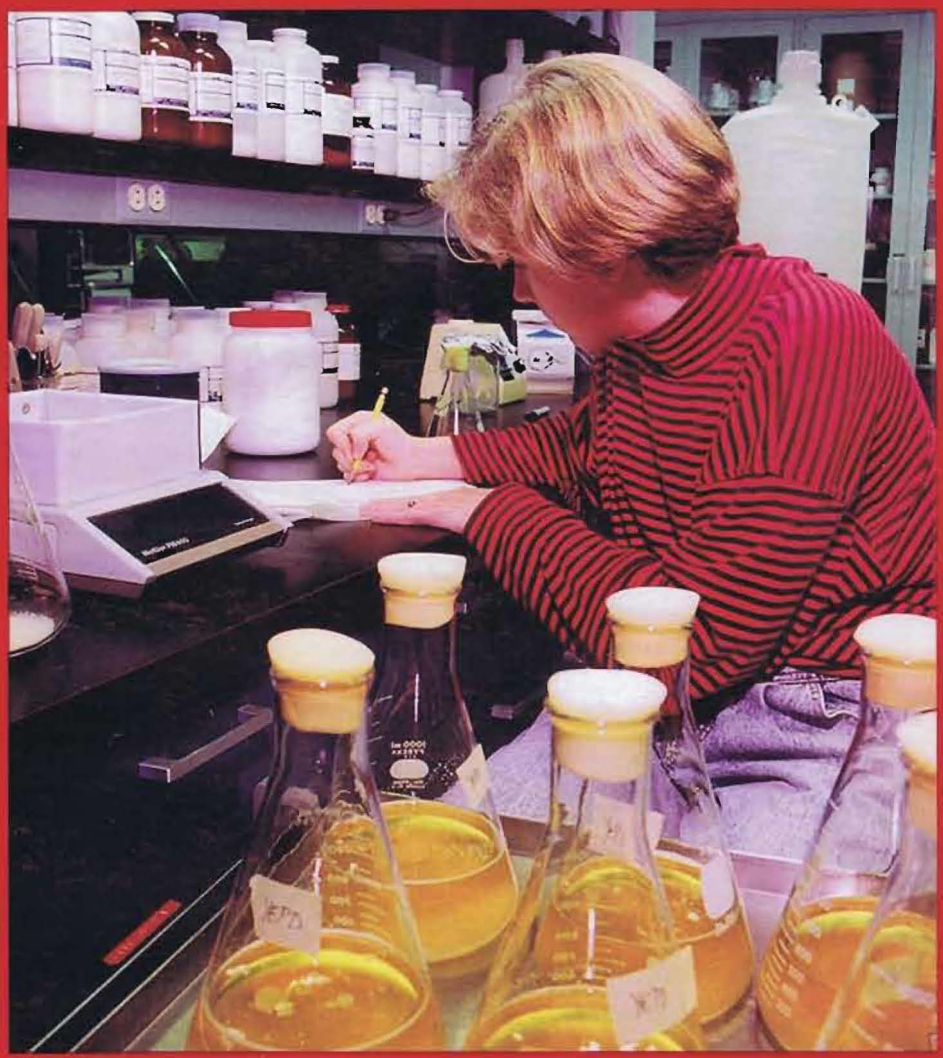
PURDUE UNIVERSITY SCHOOL OF SCIENCE

INDIANA UNIVERSITY– PURDUE UNIVERSITY INDIANAPOLIS



BULLETIN 1993-1995

Degree Programs in the School of Science

Biology
Bachelor of Arts.....(PU)
Bachelor of Science .....(PU)
Master of Science.....(PU)

Chemistry
Bachelor of Arts.....(PU)
Bachelor of Science in Chemistry .....(PU)
Master of Science.....(PU)

Computer and Information Science
Bachelor of Science .....(PU)
Master of Science.....(PU)

Geology
Bachelor of Arts.....(IU)
Bachelor of Science in Geology .....(IU)
Master of Science.....(IU)

Mathematical Sciences
Bachelor of Science .....(PU)
Master of Science.....(PU)

Physics
Bachelor of Science .....(PU)
Master of Science.....(PU)

Psychology
Bachelor of Arts.....(PU)
Bachelor of Science .....(PU)
Master of Science.....(PU)
Doctor of Philosophy in
Rehabilitation Psychology .....(PU)

Qualified students may be authorized to pursue a Purdue Ph.D. degree in a science discipline at IUPUI in areas where a program has been arranged with Purdue, West Lafayette. Please contact the department of interest at IUPUI for further details.

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Bulletin of the Purdue University School of Science 1993-1995 (IUPUI)

Indiana University–Purdue University Indianapolis (IUPUI)
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Indianapolis, IN 46202-3272

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IUPUI Calendar 1993-95

(Tentative; subject to change)

First Semester (Fall) 1993-94

Classes begin	Wednesday, August 25
Labor Day (no classes)	Monday, September 6
Thanksgiving recess begins (no classes)	Wednesday, November 24
Classes resume	Monday, November 29
Last day of classes	Monday, December 13
Final exams begin	Tuesday, December 14
Final exams end	Monday, December 22

Second Semester (Spring) 1993-94

Classes begin	Monday, January 10
Spring recess begins	Monday, March 14
Classes resume	Monday, March 21
Last day of classes	Sunday, May 1
Final exams begin	Monday, May 2
Final exams end	Sunday, May 8

Summer I 1994

Classes begin	Wednesday, May 11
Memorial Day holiday (no classes)	Monday, May 30
Classes end	Wednesday, June 22[1]

Summer II 1994

Classes begin	Monday, June 27
Independence Day holiday (no classes)	Monday, July 4
Classes end	Monday, August 8[2]

First Semester (Fall) 1994-95

Classes begin	Wednesday, August 24
Labor Day (no classes)	Monday, September 5
Thanksgiving recess begins (no classes)	Wednesday, November 23
Classes resume	Monday, November 28
Last day of classes	Monday, December 12
Final exams begin	Tuesday, December 13
Final exams end	Wednesday, December 21

Second Semester (Spring) 1994-95

Classes begin	Monday, January 9
Spring recess begins	Monday, March 13
Classes resume	Monday, March 20
Last day of classes	Sunday, April 30
Final exams begin	Monday, May 1
Final exams end	Sunday, May 7

Summer I 1995

Classes begin	Wednesday, May 10
Memorial Day holiday (no classes)	Monday, May 29
Classes end	Wednesday, June 21[3]

Summer II 1995

Classes begin	Monday, June 26
Independence Day holiday (no classes)	Tuesday, July 4
Classes end	Monday, August 7[4]

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[1]Monday, May 30 classes meet Wednesday, June 22.
[2]Monday, July 4 classes meet Monday, August 8.
[3]Monday, May 29 classes meet Wednesday, June 21.
[4]Tuesday, July 4 classes meet Monday, August 7.

Contents

IUPUI Perspective

Indiana University established its first extension center at Indianapolis in 1916, although the first IU course was taught in Indianapolis in 1890. The Purdue University Indianapolis campus grew out of World War II training programs sponsored by Purdue and began its major operations in 1946. Indiana University established the Indianapolis regional campus in the mid-1960s. In 1968, Indiana University at Indianapolis was created by the Board of Trustees, and less than a year later, in 1969, the boards of trustees of Indiana and Purdue universities merged their Indianapolis operations to form Indiana University–Purdue University at Indianapolis. Indiana University was selected to administer the campus. The name of the campus was changed to Indiana University–Purdue University Indianapolis (IUPUI) in 1992. IUPUI and IU Bloomington are the largest of Indiana University's eight campuses.

A restructuring of undergraduate programs at IUPUI in the fall of 1972 created three new schools: the School of Liberal Arts (humanities and the social sciences), the School of Science (physical, behavioral, and life sciences), and the School of Engineering and Technology. Work in the School of Liberal Arts is concentrated on the main campus, just west of downtown Indianapolis. Housed for almost 22 years on the 38th Street Campus, the School of Science is now located in two new buildings on the main campus: Science, Engineering, and Technology II and Science, Engineering, and Technology III. The final phase of this historic move consolidating the School of Science programs on the main campus will be completed in the spring of 1993.

Because IUPUI combines the arts and sciences and professions, including engineering and technology, it is the most comprehensive public institution of higher learning in the state. This broad spectrum of educational opportunities enables students to prepare for a wide range of careers. All degrees earned are from Indiana University or Purdue University.

IUPUI has an urban orientation. Most of its students commute, and many of its programs are directly related to metropolitan concerns and aspirations. IUPUI has an enrollment of more than 28,300 students, a faculty of 1,500, and a 6,800-member supporting staff. Professionals from business, industry, hospitals, and government agencies often serve as part-time lecturers in select disciplines—their practical experiences providing students with additional educational insights.

IUPUI divisions include the country's second largest medical school, a dental school with an international reputation for its research in preventive dentistry, the state's only graduate degree-granting school of nursing, and a school of allied health sciences. These, with associated teaching hospitals, clinics, and research facilities, form the state's major concentration of health care resources.

Other IUPUI units include the only graduate school of social work in the state, the country's oldest school of physical education, a law school with an urban emphasis, the nationally recognized Herron School of Art, and Schools of Business, Continuing Studies, Education, Journalism, Music, and Public and Environmental Affairs. Purdue brought to the merger a growing complex of degree programs and Purdue's traditional strengths in the physical sciences, engineering, and technology.

Both the undergraduate and graduate divisions of IUPUI are fully accredited by the North Central Association of Colleges and Schools. This assures the recognition of IUPUI credits and enables graduates to study in virtually any school in the nation. Because of the organization of the School of Science, all degrees awarded are Purdue University degrees, except those given in geology, which are Indiana University degrees.

The School of Science

The School of Science offers many undergraduate and graduate programs that will prepare students for a variety of careers now open to scientists. Scientists are encouraged by society to pursue new avenues of research, either as individuals or as part of research teams employing many scientists. Needed to design computers and computer programs, to locate and analyze natural resources, and to help find ways to protect our environment, scientists can apply research findings to industrial and human problems. They are sought as administrators for governmental organizations using other scientists and as salespersons and managers by companies with science-based products.

One goal of the School of Science is to help persons who seek a general education with emphasis on the scientific aspects of our culture, rather than a career in science per se. Undergraduate training in one or several of the sciences is considered excellent background for graduate study in medicine (including veterinary medicine), dentistry, business administration, law, and areas of the social sciences where quantitative methods are important.

Supplementing the full-time instructional staff, with ranks ranging from instructor through full professor, is a contingent of well-qualified, experienced lecturers who are recruited from the reserve of talent existing in the Indianapolis area.

The School of Science offers Bachelor of Arts degrees in biology, chemistry, geology, and psychology. Bachelor of Science degrees are offered in biology, chemistry, computer science, geology, mathematics, physics, and psychology. Master of Science degrees are offered in biology, chemistry, computer science, geology, mathematics, physics, and psychology. A Ph.D. program in rehabilitation psychology is also offered. All degrees awarded are Purdue University degrees, except those given in geology, which are Indiana University degrees. Qualified students may be authorized to pursue a Purdue Ph.D. degree at IUPUI in areas where a program has been arranged with Purdue, West Lafayette.

Awards

The faculty cooperates in nominating students for various annual awards offered by the School of Science departments or by organizations interested in science education.

School of Science

John D. Barnwell Memorial Scholarship for a student in the School of Science or School of Liberal Arts who has effectively integrated the sciences and the arts in his or her undergraduate career.

Frank Lambertus Memorial Scholarship for the student who has shown outstanding academic progress since the previous year.

D. J. Angus—Scientech Award for the student who has shown greatest improvement in academic performance since the previous year.

Department of Biology

Award for Outstanding Academic Achievement for the student with the best overall academic record in the Department of Biology.

Biology Research Award for the student making the most outstanding contribution to his or her area of scientific research.

Ronald E. Kirk Memorial Award for the outstanding freshman biology student.

Department of Chemistry

Academic Achievement Award for the graduating senior with highest achievement in a Bachelor of Arts degree program.

Loren T. Jones Award for the graduating senior with the highest academic achievement in a Bachelor of Science degree program.

Frank J. Welcher Award for the graduating senior with greatest professional promise.

Chemical Rubber Company Outstanding Freshman Award for the outstanding student in general chemistry.

Outstanding Undergraduate Analytical Chemistry Award sponsored by the American Chemical Society.

Loren T. Jones Memorial Scholarship for summer support of an outstanding chemistry major.

Lilly Undergraduate Research Scholarship for summer research support in analytical and organic chemistry.

Scott Alan Kent Memorial Scholarship for a promising sophomore or junior chemistry major.

American Institute of Chemists Student Research and Recognition Award for an outstanding senior student majoring in chemistry.

Eli Lilly Teaching Fellowship Award for outstanding and meritorious performance in classroom teaching by graduate students.

Department of Computer and Information Science

Gersting Undergraduate Student Award for an outstanding major in computer and information science.

Gersting Graduate Student Award for an outstanding graduate student in computer and information science.

Department of Geology

Academic Achievement Award for the graduating senior with highest academic achievement.

Leadership and Service Award for the graduating senior with outstanding leadership and service to the department.

Indiana Geology and Gem Society Scholarship for a sophomore or junior geology major.

Geology Alumni Scholarship for a senior-year undergraduate geology major.

Department of Mathematical Sciences

Anna K. Suter Award for the outstanding senior mathematics major.

Anna K. Suter Scholarship for undergraduate mathematics majors. It is renewable based on academic performance.

Outstanding Student Award for an outstanding junior or senior (or both) based on achievements in advanced mathematics.

Department of Physics

Academic Achievement Award for the physics major with the best academic record.

Golden A. Flake Award for the best student in the elementary physics course sequence for science majors.

Department of Psychology

Robert G. Neel Award for the graduating psychology major with highest academic achievement.

Robert I. Long Award for the most outstanding graduating psychology major.

Student Research Award for the psychology major who has demonstrated the most skill as a research scientist.

Graduate Psychology Awards for the most outstanding graduate student in the industrial/ organizational psychology and M.S. and Ph.D. clinical rehabilitation psychology programs.

In addition, many science honor students compete successfully for Outstanding Freshman Scholarships and Outstanding Upper Class Scholarships awarded by IUPUI. Freshmen with a high level of achievement are eligible for election to the IUPUI chapters of Alpha Lambda Delta and Phi Eta Sigma honoraries. Psychology majors may be elected to Psi Chi Honorary, which recognizes outstanding students in that discipline.

Student Welfare and Responsibility

All colleges and universities establish certain academic requirements that must be met before a degree is granted. These regulations concern such things as curricula and courses, majors and minors, and campus residence. Advisers, directors, and deans will aid students in meeting these requirements, but students are responsible for fulfilling them. At the end of the course of study, the faculty and the Board of Trustees vote on the conferring of degrees. If requirements have not been satisfied, degrees will be withheld pending adequate fulfillment. For this reason, it is important for students to acquaint themselves with all regulations and to remain informed throughout their university career.

This bulletin lists the requirements and regulations in effect for students who are admitted to the School of Science in August 1993 (fall semester). Students who enter after this date may be subject to different requirements; students who entered prior to August 1993 may elect to follow the graduation requirements that were in effect at the time of their admission to their degree program or the graduation requirements that became effective thereafter. However, the requirements chosen must be from only one bulletin. If a student has not completed a degree program within eight years of admission, the student may be obliged by the major department to meet the requirements of a subsequent bulletin. Additionally, students in good standing who have not been enrolled at the university for two or more consecutive years must satisfy the requirements of the School of Science bulletin in effect upon their return.

Program Planning and Counseling Guidelines

The experience of academic advisers and of successful students suggests the following guidelines for effective planning of undergraduate programs:

1. Students should be thoroughly familiar with all academic requirements that must be met before a degree is granted.
2. Students should seek appointments with academic advisers in their major departments on or before the dates established by the university calendar for academic counseling. In such conferences students should, as a minimum objective, make certain that they review their degree requirements and that they have made an appropriate plan for the next semester.
3. Each student should understand that the responsibility for making an appropriate academic program and for meeting every degree requirement rests with the student; faculty or staff members acting in the capacity of advisers are obligated only to assist students in meeting this responsibility. Any student who needs clarification of any of the requirements for the degree program is urged to obtain this clarification from an academic adviser or from the Office of the Associate Dean for Academic Programs and Student Development; School of Science; Science, Engineering, and Technology III, Room 3224; 402 N. Blackford Street [(317) 274-0626].

Confidentiality of Student Records

Indiana University, in compliance with the General Education Provisions Act, Section 438, titled Family Educational Rights and Privacy Act, provides that all student records are confidential and available only to the student and to the student's parents, if the student is under 21 and dependent as defined by Internal Revenue Service standards. Students may review their records upon request and may ask for deletions or corrections of the record in a hearing process described in detail in the booklet *Code of Student Ethics*. References, recommendations, and other similar documents may carry a voluntary waiver relinquishing the student's right to review this specific material. Students may also release the record to others by signing a written release available in the offices that maintain records. Further details regarding the provisions of the Privacy Act may be found in the booklet *Code of Student Ethics*, available in the Office of the Dean for Student Affairs, Union Building 129, 620 Union Drive [(317) 274-2546].

Student Conduct

Rules for student conduct are in keeping with the diverse nature of the student body and faith of the university in student responsibility.

A code of student conduct, enacted by the governing Indiana University Board of Trustees, is designed to assure due process for all students requiring disciplinary action. Student academic conduct is the responsibility of the dean of each school or academic division. The dean for student affairs has the assignment of implementing central administration action if necessary. More information can be obtained in the booklet *Code of Student Ethics*.

Career and Employment Services

The Office of Career and Employment Services helps students and graduates evaluate career interests and opportunities and provides assistance to graduating students in job-search strategies, resume preparation, interviewing techniques, and on-campus recruiting interviews.

The office maintains a career resource library containing company literature, occupational and career information, employment trends, and specific full-time employment opportunities at both the graduate and undergraduate levels.

Recruiting companies interview graduating students on campus during the fall and spring semesters. Students may take advantage of this opportunity by registering with the Office of Career and Employment Services, Business/SPEA Building 2010, 801 W. Michigan Street [(317) 274-2554].

Information about specific career fields is also available in the School of Science dean's office and in departmental offices.

Campus Housing

Admission to the university does not guarantee campus housing accommodations at IUPUI. Students must file separate applications for housing in order to reserve spaces and should apply as soon as they decide to attend school at this campus. Assignments are made based on the date of receipt of the application and the $15 application fee. Persons may apply for housing even though they are not yet admitted to the university. Waiting lists may exist for certain types of accommodations.

Students interested in living on campus may apply to live in the Ball Residence Hall, Graduate Townhouse Apartments, or Warthin Apartments. Within the Warthin apartment building is the International House, which houses about 50 students and researchers from the United States and other countries. Accommodations for students with disabilities are available. Campus housing is allocated on a first-come basis.

Current room and board rates for Ball Residence are approximately $3,200 per academic year. International House rates range from $1,901 to $2,030 per academic year, and current rates for on-campus apartments range from $328 to $584 per month, including utilities. For additional information, contact the Department of Campus Housing, Ball Residence 107, 1226 W. Michigan Street, IUPUI, Indianapolis, IN 46202-5180 [(317) 274-7200].

Information for International Students

International students applying to study at IUPUI use the international application. In addition to demonstrating academic qualifications, they must show proficiency in English and proof of financial support before the travel documents are issued. Application information may be obtained from the Office of International Affairs, Union Building 207, 620 Union Drive, IUPUI, Indianapolis, IN 46202-2897, U.S.A. [(317) 274-7294]. The Office of International Affairs is responsible for all travel documents and immigration concerns, and provides information about orientation, adjustment to American living, and activities. Upon their arrival, all international students and exchange visitors are asked to report to the Office of International Affairs, Union Building 207.

Nondiscrimination Policy

Indiana University–Purdue University Indianapolis is committed to equal opportunity for all persons and provides its services without regard to gender, age, race, religion, ethnic origin, sexual orientation, veteran status, or disability. An Affirmative Action office on each campus monitors the university's policies and assists individuals who have questions or problems related to discrimination.

Expenses and Financial Aid

Costs and Fees

The cost of attending IUPUI generally is related to the number of credit hours taken by the student. The fee structure for general academic areas of IUPUI as of fall 1992 is as follows:

	Resident	Nonresident
Undergraduate	$ 80.50/credit hour	$242.60/credit hour
Graduate	$107.85/credit hour	$311.05/credit hour

The technology fee is assessed according to a student's class standing code, as follows.

Technology Fee	1-3 cr. hrs.	4-6 cr. hrs.	7 or more cr. hrs.
Freshman (A1, B1, P1)	$25.00	$50.00	$75.00
Sophomore (A2, B2, P2)	9.65	19.25	28.90
Junior (B3)	8.60	17.15	25.70
Senior/Special (B4, B9)	7.50	15.00	22.50

There may be other fees, such as laboratory fees, late registration fees, parking fees, and special fees for certain courses and programs.

Fees are subject to change without notice by action of the Board of Trustees of Indiana University. Inquiries about fees should be directed to the Office of the Bursar, Cavanaugh Hall 147, 425 University Blvd., IUPUI, Indianapolis, IN 46202-5142 [(317) 274-2451]. Specific information about student fees and fee-related processes is given in the IUPUI *Schedule of Classes*.

Full-time undergraduate students usually enroll for 15 to 17 credit hours per semester; thus an academic year for an in-state resident costs about $3,200 for fees, books, and class supplies. Other expenses such as transportation, food, and entertainment vary according to individual needs.

Refund Policy

Refunds during the fall and spring semesters and summer sessions are determined by the date of withdrawal as indicated below. Deadlines are calculated based on the first day of classes as stated in the IUPUI *Schedule of Classes*.

Courses scheduled 9-16 weeks in length		Courses scheduled 5-8 weeks in length	
1st week	100% refund	1st week	100% refund
2nd week	75% refund	2nd week	50% refund
3rd week	50% refund	3rd week	No refund
4th week	25% refund		
5th week	No refund		

To be eligible for a refund, students must submit a schedule adjustment form to the Office of the Registrar, Cavanaugh Hall 133, 425 University Blvd., for the course they wish to drop. Refund amounts are determined by the official date on which the withdrawal form is received by the IUPUI Office of the Registrar.

Credit by Examination

The following policies apply to special credit awarded as the result of an examination:

1. If the special credit is awarded to a student of freshman class standing, there is no charge.
2. If the student is a first-semester transfer student, there is a charge of $13 per credit hour.
3. If neither of the above conditions apply, the standard resident or nonresident credit hour charge will be assessed.

Credit by Credentials and/or Experience

Special credit awarded as a result of credentials or experience will be assessed at the rate of $12 per credit hour, not to exceed $60 per course.

Health Care and Insurance

Student Employee Health Service (SEHS) is located in Coleman Hall at the IU Medical Center. The hours are 8:30 a.m. to 5:00 p.m., Monday through Friday. All IUPUI students may be seen on a fee-for-service basis. Applications for health insurance are also available in SEHS.

Financial Aid

It is the philosophy of IUPUI to encourage students in their educational goals and to reduce financial barriers. The university recognizes that many students and their parents cannot afford to finance a college education entirely from their own income and assets. For this reason, a program of financial assistance is available to admitted and enrolled students who have a demonstrated financial need. Aid is available in the form of grants, loans, and participation in the work-study program. Academic scholarships are also offered. For priority consideration, students should apply for financial assistance before March 1 for the following academic year.

Individuals seeking further information about any of the financial aid programs should write to the Office of Scholarships and Financial Aid, Cavanaugh Hall 103, 425 University Blvd., IUPUI, Indianapolis, IN 46202-5145, or call (317) 274-4162.

Veterans Benefits

Students eligible for education benefits from the Veterans Administration enroll according to the following benefits scale:

Undergraduate Benefits	**Fall & Spring Semesters**	**Summer I & II**[1]
Full time	12 cr. or more	6 cr.
Three-quarters time	9-11 cr.	5, 4 cr.
One-half time	6-8 cr.	3 cr.
Tuition only	fewer than 6 cr.	1 cr.
Graduate Benefits	**Fall & Spring Semesters**	**Summer I & II**[1]
Full time	8 cr. or more	4 cr.
Three-quarters time	5-7 cr.	3 cr.
One-half time	4 cr.	2 cr.
Tuition only	fewer than 4 cr.	1 cr.

Further information on benefits, including Veterans Administration paid tutorial assistance and work-study opportunities, is available from the veterans affairs representatives at the Office of the Registrar, Cavanaugh Hall 133, 425 University Blvd., IUPUI, Indianapolis, IN 46202-5144 [(317) 274-1521 or (317) 274-1522].

Admissions and Transfers

All students entering the School of Science must have been officially admitted to the university by the Office of Admissions, Cavanaugh Hall 129, 425 University Blvd., IUPUI, Indianapolis, IN 46202-5143 [(317) 274-4591]. Further information and application forms may be obtained at this address. All applications for admission must be accompanied by a $25 nonrefundable fee. Checks should be made payable to IUPUI.

IUPUI offers instruction during two semesters and two six-week summer sessions. Students may start a program of study with any regularly scheduled session. Sessions begin in August, January, May, and June.

Beginning Students

Students entering IUPUI directly from high school should file their application for admission at the end of their junior year.

Acceptance to the university as a new student is influenced by several factors. The Office of Admissions is guided by the following:

1. The applicant should be a graduate of a high school accredited by a state Department of Public Instruction.
2. The extent to which the student meets or exceeds the minimum subject requirements indicated below is considered. For admission to the School of Science, the student's record should include the following course work:

Subjects	**Semesters**
English	8
History and social studies	4
Algebra	4
Geometry	2
Trigonometry[2] (see statement below)	1-2
Laboratory science	2
Combination of foreign language, additional math, laboratory science, social science, or computer science courses	6-7

Students may be admitted with some deficiencies in mathematics or laboratory science. Such deficiencies may be removed by taking courses offered by the School of Science. However, these courses may not be counted as credit toward a School of Science degree. If the high school offers more than the above mathematics courses, students may benefit from taking analytic geometry (precalculus mathematics). It is advised that one semester of chemistry be included in laboratory science.

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[1]See the veterans affairs representative at the Office of the Registrar to discuss benefits for summer sessions.
[2]Students who plan to major in chemistry, computer science, or physics need to have taken an advanced mathematics course that includes trigonometry.

In planning high school electives, the curricula of the various departments of the School of Science contained in this bulletin should be reviewed. Departmental counselors will be glad to help with preplanning for admission.

3. All applicants are required to take the Scholastic Aptitude Test (SAT) or the American College Test (ACT). It is recommended that these tests be taken in the spring of the student's junior year in high school.
4. Indiana Residents
   a. Residents of Indiana must rank in the upper half of their high school graduating class or have a combined verbal-math SAT score of 950. In either case, neither SAT score may be below 400.
   b. Residents of Indiana must rank in the upper half of their high school graduating class or have an ACT composite score of 23. In either case, neither the verbal nor math ACT score may be below 18.
   c. A marginal applicant may be granted admission, admitted on probation, or have admission denied.
5. Out-of-State Residents
   If enrollment limits are in place, out-of-state applicants must rank in the top third of their high school graduating class. They must also rank in the top third of the IUPUI distribution on the SAT or ACT.
6. Information provided by the high school counselor is considered.

Students should declare a major when applying for admission so that a departmental adviser can be assigned. Premedical and predental students should declare a chemistry or biology major at the time of admission.

Advanced Academic Standing

College credit may be obtained in certain areas based on scores achieved in College Board Advanced Placement (AP) or College Level Examination Program (CLEP) examinations. For more information, contact the Office of Admissions, Cavanaugh Hall 129 [(317) 274-4591]. In addition, on the basis of departmental examinations, departmental credit and/or advanced placement may be awarded. To determine qualifications for such consideration, consult the department concerned.

Special Pre–College-Age Nondegree Programs (SPAN)
The SPAN program allows middle and high school students ranking in the top 10 percent on nationally standardized tests (SAT, PSAT, etc.) and senior-year high school students ranking in the top 20 percent of their class to earn college credit prior to their graduation from high school. This permits them to be challenged in courses not available in their own schools and to develop better study and research skills while continuing their normal junior or senior high school education. To determine qualification, students should consult their high school counselor and the Honors Program at IUPUI [(317) 274-3118].

Transient Students

It is the responsibility of transient students to determine whether credit hours earned at IUPUI may be applied toward the degree being sought from one's own university.

Transfer Students

From IUPUI Schools, Indiana University Campuses, and Purdue University Campuses
Prospective transfer students should have a minimum grade point average of 2.0 on a 4.0 scale and be in good disciplinary standing. In order to be accepted for admission to the School of Science, students must first complete the processing of appropriate materials as indicated below. Acceptance to the school also requires the signature of the chairperson of the department approving the request to pursue a degree program and the signature of the associate dean for academic programs and student development of the School of Science.

1. An IUPUI student must file a record change form, which may be obtained from the Office of the Associate Dean for Academic Programs and Student Development of the School of Science or the student's current school.
2. A student at another Indiana University campus must file an intercampus transfer form, which may be obtained from the Office of the Dean of the campus where the student is enrolled.
3. A Purdue University campus student must make an official application through the IUPUI Office of Admissions.

From Other Colleges and Universities
Students who have earned transfer credit for 12 credit hours and have a cumulative grade point average of 2.0 (2.5 for nonresidents of Indiana) on a 4.0 scale from other institutions may be admitted to the School of Science. Admittance to the school is contingent upon acceptance into a departmental program. Students should submit the following with their application for admission:

1. A copy of their high school record showing satisfactory completion of entrance requirements;
2. An official transcript of work completed in each institution previously attended;
3. Evidence of good academic and disciplinary standing at the institution last attended.

Credit from other institutions is evaluated by the Office of Admissions, and its applicability toward degree requirements in the School of Science is determined by the major department and the Office of the Associate Dean for Academic Programs and Student Development.

Transfer Credit

Acceptability of transfer credits from another college or university is determined by the student's major department and the Office of the Associate Dean for Academic Programs and Student Development. However, transfer credit will be allowed for the master's degree only after one semester of satisfactory work in residence at IUPUI.

From IUPUI to Other Indiana University and Purdue University Campuses
Students transferring from IUPUI to other Indiana University and Purdue University campuses should consult the appropriate departments at those campuses about equivalence of courses.

International Students

See the paragraph under "Student Welfare and Responsibility, Information for International Students" in this bulletin.

Graduate Students

To be considered for admission, candidates must have a baccalaureate degree from an accredited institution and must show promise of ability to engage in advanced work and evidence of adequate preparation to pursue graduate study in their chosen field. The minimum standard for unconditional admission to the Graduate School is a graduation grade point average of 3.0 (B) or the equivalent. An applicant not meeting these requirements should take the Aptitude Tests Section of the Graduate Record Examination. Individual departments may set higher grade point requirements and may require the submission of additional evidence of academic performance, such as Graduate Record Examination (GRE) scores.

A minimal score of 550 on the Test of English as a Foreign Language (TOEFL) is required for admission to the Graduate School for all applicants whose native language is not English. Departments may set higher requirements.

Application should normally be made at least three months before the beginning of the session in which the student wishes to enroll. However, late applications will also be accepted. Applicants will be advised of the action taken on their applications by the dean of the Purdue University Graduate School. Applications to the Department of Geology will be considered by the dean of the Indiana University Graduate School; applicants will be notified of the results by the graduate adviser in the Department of Geology.

Qualified students may be authorized to pursue a Purdue Ph.D. degree at IUPUI in areas where a program has been arranged with Purdue, West Lafayette. For further details, contact the department in which study is desired.

Financial support in the form of teaching and research assistantships is available through the departments of the School of Science. Students who want to be considered for IUPUI fellowships must submit GRE (verbal/quantitative/analytic) scores. Area examination scores may also be submitted for consideration.

Regular Graduate Student Application
Application forms for admission as a regular graduate student may be obtained from the major department.

Applicants must submit complete, official transcripts of all previous college and university studies and three letters of academic reference for evaluation by the major department.

Graduate Continuing Nondegree Program
The graduate continuing nondegree classification is normally used for two groups of students: (1) Students who are working on prerequisites or are in the process of filing for admission into a graduate degree program; (2) Nondegree students whose intent is to take course work for personal improvement. A student who wishes to become a candidate for an advanced degree should consult with the chosen major department at the time of application for admission as a graduate continuing nondegree student. The major department will advise applicants of the procedure for obtaining regular graduate student status. Admission as a graduate continuing nondegree student is obtained through the IUPUI Graduate Office, Union Building A203, 620 Union Drive, Indianapolis, IN 46202-5167 [(317) 274-1577].

No more than 12 hours of credit earned under this classification may be used on a plan of study for a Purdue University degree program without approval of the major department and the Purdue Graduate School. Similarly, not more than 9 hours of credit earned under this classification may be used in a plan of study for an Indiana University degree program without approval of the major department.

Undergraduate Programs

Baccalaureate Degree

General Requirements

1. A minimum of 124 credit hours (122 for geology) must be completed. Acceptance must be obtained from the Office of the Associate Dean for Academic Programs and Student Development to use as credit toward graduation any course that was completed 10 or more years previously.
2. A minimum grade point average of 2.0 is required.
3. A minimum of 24 credit hours must be taken in a major subject (see departmental requirements) with a minimum grade point average of 2.0. No grade below C– is acceptable in the major subject.
4. A minimum of 9 credit hours in the major subject must be completed at IUPUI (see departmental requirements).
5. Residence at IUPUI for at least two semesters and completion, while at IUPUI, of at least 32 credit hours of work in courses at the 300 level or higher are required.
6. With the approval of the associate dean for academic programs and student development, students who have had at least four semesters of resident study may complete up to 15 credit hours of the senior year at another approved college or university.
7. Courses taken on the Pass/Fail option can be applied only as general electives and not toward degree area requirements of the school or department.
8. No more than 60 credit hours earned in accredited junior colleges can be applied toward a degree.
9. Students may enroll in Independent Study (correspondence) courses for general electives up to a maximum of 12 credit hours with permission of the associate dean for academic programs and student development. Also, with permission of the department, credit may be earned through special credit examination. Credits earned by special credit examination may be used toward the total credit hours required and to satisfy area requirements for a degree.
10. The following courses do not count for any credit toward any degree program in the School of Science: AGR 101; BIOL N120; CHEM C100; all COAS courses; EDUC U205, X150, X151, X152; ENG W001; and MATH 001, 002, 111, 123, 130, 131, 132.
11. Courses taken outside of the Schools of Science and Liberal Arts must receive departmental approval. No more than 6 credit hours of clinical, athletic, or performing arts course work will be approved. See the departmental adviser for details.
12. In general, credit is not allowed for both of two overlapping courses. See the departmental adviser for details.
13. An application for a degree must be filed in the Office of the Recorder; School of Science; Science, Engineering, and Technology III, Room 3224 [(317) 274-0626] at least one semester prior to the anticipated graduation date. Degrees are conferred in May, August, and December; commencement is held only in May. Candidates for degrees in August may participate in May commencement.

Area Requirements
The Faculty of the School of Science has adopted the following degree requirements for the Bachelor of Arts and Bachelor of Science degrees. Students may follow the School of Science and departmental requirements that are in effect when they enter the School of Science, or they may

choose new requirements that become effective after that date. However, the requirements must be chosen from only one bulletin. A student who has not completed a degree program within eight years of entering the School of Science may be obliged by the major department to meet the requirements of a subsequent bulletin. School of Science requirements are the minimal requirements in various areas, and individual departments *may require more* as stated in their degree descriptions. Students should consult with departmental advisers in planning their courses of study.

Students should note the following:

1. Check departmental descriptions for courses that are considered overlaps. Some courses may not be used to fulfill distribution requirements. Students should consult with their advisers on these points.
2. Cross-listed courses may count only once in fulfilling requirements.
3. English W131 and other composition courses may not be used to complete the Area III requirements.
4. It is recommended that a student who intends to pursue graduate studies plan to take the Graduate Record Examination (GRE) at the beginning of the senior year.

Bachelor of Arts Degree

Area I

English Composition and Communicative Skills Two courses in English composition worth at least 3 credit hours each and one course in speech skills worth at least 3 credit hours are required. The English composition requirement is partially satisfied by completing ENG W131 (or ENG W140). A second course, in technical or research writing, may be used to complete the composition requirement. Consult departmental guidelines. A grade of C or better must be obtained in both composition courses.

Area II

Foreign Language No courses are required by the School of Science. Consult departmental requirements.

Area III

IIIA Arts and Humanities Four courses totaling at least 12 credit hours are required. There must be at least two courses in one discipline in either IIIA or IIIB. History is cross-listed and may be used in IIIA or IIIB, but not both.

American Studies	Japanese
English	Journalism
Fine Arts	Music
Folklore	Philosophy
French	Religious Studies
History	Spanish
German	Theatre

Performing arts and studio courses do not fulfill arts and humanities requirements. Writing courses are not accepted as English or journalism courses.

IIIB Social and Behavioral Sciences Four courses outside the major department totaling at least 12 credit hours are required. There must be at least two courses in one discipline in either IIIA or IIIB. History is cross-listed and may be used in IIIA or IIIB, but not both.

Anthropology	Linguistics
Economics	Political Science
Geography	Psychology
History	Sociology

IIIC Physical and Biological Sciences At least four science courses totaling a minimum of 12 credit hours outside the major department are required. At least one of the courses must be a laboratory course. Not acceptable are BIOL N100, N120, N200; CHEM C100; GEOL G130; and all agriculture courses. *In addition, students must obtain grades of C– or higher in their Area IIIC courses; a single grade of D+ or D will be allowed for one course only.* Check with the major department for additional restrictions or requirements.

Biology	Geology
Chemistry	Physics (including Astronomy)

IIID Mathematical Sciences One course of at least 3 credit hours in mathematics and one course of at least 3 credit hours in computer science (CSCI) are required. MATH 001, 002, 111,

123, 130, 131, and 132 do not count for any credit toward any degree in the School of Science, however. *In addition, students must obtain grades of C– or higher in their Area IIID courses; a single grade of D+ or D will be allowed for one course only.* Check with the major department for additional restrictions or requirements.

Computer Science
Mathematics
Statistics

Area IV

Major Department Consult the listing of the major department for courses required within the major subject as well as courses required by the major department in the other areas.

Bachelor of Science Degree

Area I

English Composition and Communicative Skills Two courses in English composition worth at least 3 credit hours each and one course in speech skills worth at least 3 credit hours are required. The English composition requirement is partially satisfied by completing ENG W131 (or ENG W140). A second course, in technical or research writing, may be used to complete the composition requirement. Consult departmental guidelines. A grade of C or better must be obtained in both composition courses.

Area II

Foreign Language No courses are required by the School of Science. Consult departmental requirements.

Area III

IIIA Arts and Humanities Two courses totaling at least 6 credit hours are required. There must be two courses in one discipline in either IIIA or IIIB. History is cross-listed and may be used in IIIA or IIIB, but not both.

American Studies
English
Fine Arts
Folklore
French
History
German
Japanese
Journalism
Music
Philosophy
Religious Studies
Spanish
Theatre

Performing arts and studio courses do not fulfill arts and humanities requirements. Writing courses are not accepted as English or journalism courses.

IIIB Social and Behavioral Sciences Two courses outside the major department totaling at least 6 credit hours are required. There must be two courses in one discipline in either IIIA or IIIB. History is cross-listed and may be used in IIIA or IIIB, but not both.

Anthropology
Economics
Geography
History
Linguistics
Political Science
Psychology
Sociology

IIIC Physical and Biological Sciences At least four science courses totaling a minimum of 12 credit hours outside the major department are required. At least one of the courses must be a laboratory course. Not acceptable are BIOL N100, N120, N200; CHEM C100; GEOL G130; and all agriculture courses. *In addition, students must obtain grades of C– or higher in their Area IIIC courses; a single grade of D+ or D will be allowed for one course only.* Check with the major department for additional restrictions or requirements.

Biology
Chemistry
Geology
Physics (not including Astronomy)

IIID Mathematical Sciences At least two courses beyond algebra and trigonometry, totaling a minimum of 6 credit hours, are required. In addition, one course of at least 3 credit hours in computer science (CSCI) is required. Courses in applied statistics are not acceptable. *In addition, students must obtain grades of C– or higher in their Area IIID courses; a single grade of D+ or D will be allowed for one course only.* Check with the major department for additional restrictions or requirements.

Computer Science
Mathematics
Statistics

Area IV
Major Department Consult the listing of the major department for courses required within the major subject as well as other courses required by the major department in other areas.

Minors

See the departmental sections of this bulletin for information on minor fields of study. Independent Study (correspondence) courses may not be used to fulfill a minor program.

Requirements for minors offered by departments in the School of Science are as follows:
1. A minimum of 18 credit hours must be taken in a minor subject.
2. A minimum of 6 credit hours in the minor subject must be taken at IUPUI.
3. No grade below C– is acceptable in the minor subject.
4. A minimum grade point average of 2.0 is required for the complete minor program.

Graduate Programs

Master of Science degrees are offered in biology, chemistry, computer science, geology, mathematics, physics, and psychology. A Ph.D. program in rehabilitation psychology is also offered. All degrees awarded are Purdue University degrees, except that given in geology, which is an Indiana University degree. Qualified students may be authorized to pursue a Purdue Ph.D. degree at IUPUI in areas where a program has been arranged with Purdue, West Lafayette. For information on Ph.D. programs, consult the departmental sections of this bulletin.

Purdue University Graduate Degrees

General Requirements
1. Students must have regular graduate student standing.
2. Students must satisfy the English requirement. All degree-seeking graduate students are required to demonstrate acceptable proficiency in written English before filing a plan of study. Candidates for advanced degrees whose native language is English satisfy the English requirement if (1) they earned grades of B or better in graded undergraduate courses in written English prior to graduate admission (Pass/Fail or S grades are not acceptable), (2) they attain scaled scores of 600 or higher on the Verbal Aptitude Section of the Graduate Record Examination (GRE) or 36 or higher on the verbal portion of the Graduate Management Admission Test (GMAT), or (3) they can certify exemption from undergraduate composition on the basis of both a Scholastic Aptitude Verbal test score of at least 650 and a rank in the upper 10 percent of their high school graduating class. If the student takes the GRE or the GMAT after applying for admission to the Graduate School, the student must be certain the Educational Testing Service sends test scores to the Graduate School. Students who do not meet the above requirements must write a test paper for the Writing Review Committee. They are remanded for further writing if the test paper is not acceptable and are expected to work toward satisfying the requirement without delay. The student should make certain that the Writing Review Committee notifies the Graduate School when the English requirement has been satisfied. See the administrative assistant in the Office of the Associate Dean for Academic Programs and Student Development for the person to contact for clearance in this manner.
3. Students must file a plan of study. The plan of study shall include a primary area and may include a related area or areas that are chosen on the basis of the student's interests and needs. A tentative plan of study should be drawn up in advance of registration for the first semester of graduate work. This should be done by the student and the individual graduate adviser. The formal plan of study should be submitted as soon as possible and before the final semester. The English requirement must be met before the plan of study may be filed.
4. Students must meet the grade and grade point average requirements. Only grades of A, B, and C are acceptable in fulfilling Graduate School requirements in any plan of study. An advisory committee or department may require a grade higher than C in certain courses. There is no general Graduate School cumulative grade point average requirement. Specific cumulative grade point average requirements, if any, are up to the individual departments.
5. Students must complete the credit hours of work required. This varies by department.
6. Students must fulfill departmental requirements regarding oral and written examinations. The Graduate School has no general requirement for oral and written examinations for the nonthesis master's degree. In any department the final examination may be waived if the student meets the minimum requirements of the department. In any event, a final examining

committee is appointed for each candidate for the master's degree. The committee must certify to the Graduate School either that the student has passed the required examinations of the department in which the major graduate study has been taken or that the committee is satisfied with the accomplishment of the student as based on a committee conference.

Other regulations or requirements may be found in the Purdue University Graduate School Bulletin.

A student who has previously earned a bachelor's degree may enroll in graduate courses without making formal application as a degree-seeking student. Application as a graduate continuing nondegree student is, however, required and may be accomplished through the IUPUI Graduate Office, Union Building 203, 620 Union Drive, IUPUI, Indianapolis, IN, 46202-5167 [(317) 274-1577]. A maximum of 12 credit hours of courses completed as a graduate continuing nondegree student may be used in completing the requirements of a degree upon acceptance as a degree-seeking student and upon departmental approval.

Indiana University Graduate Degrees

Consult the Department of Geology section of this bulletin for information. A maximum of 9 credit hours of course work completed as a graduate continuing nondegree student may be used in completing the requirements of a degree upon acceptance as a degree-seeking student and upon departmental approval.

Academic Regulations

Grades

The School of Science uses a grading system that may include plus and minus grades, as well as straight grades, for all undergraduate and graduate courses.

A+	(4.0)
A	(4.0)
A–	(3.7)
B+	(3.3)
B	(3.0)
B–	(2.7)
C+	(2.3)
C	(2.0)
C–	(1.7)
D+	(1.3)
D	(1.0)
D–	(0.7)
F	(0.0) (No credit) Failed the work in a course or failed to complete an official withdrawal
R	(Deferred Grade)
S	Satisfactory
P	Passed (See Pass/Fail option)
F	Failing (See Pass/Fail option) (No credit)

Instructors have the prerogative of using the plus-minus or the conventional grading system for their courses.

Pass/Fail Option During the four years of their undergraduate program, all undergraduates in good standing (not on probation) may enroll in up to eight elective courses to be taken with a grade of P or F. The Pass/Fail option is open for a maximum of two courses per year, including summer sessions. For this option, the year is defined as August 15 to August 15. The Pass/Fail option form is available in the School of Science departmental offices and in the Office of the Associate Dean for Academic Programs and Student Development; Science, Engineering, and Technology III, Room 3224 [(317) 274-0626].

The course selected for Pass/Fail grading must be an elective. It may not be used to satisfy any of the school area requirements, nor may it be counted as a part of the student's concentration area. The course or courses may be used to meet the 300–400-level course requirement. A grade of P cannot be changed subsequently to a grade of A, B, C, or D.

Computation of GPA To compute the grade point average (GPA), the number of grade points received (4.0 for an A, 3.0 for a B, etc.) is multiplied by the number of credit hours assigned for

each course. The sum of grade points received for all courses is then divided by the total number of course credit hours. Grades of P and S are not included in the computation; a grade of F is included.

Withdrawal Students may officially withdraw from classes without penalty during the first half of a semester or session if they secure the approval of their adviser; a grade of W (Withdrawal) is recorded on the final grade report. Students may withdraw from classes during the third quarter of a semester or session if they secure the approval of their adviser and the instructor of the course; a grade of W or F may be assigned by the instructor of the course. The grade so assigned is recorded on the final grade report. Students may withdraw from classes during the last quarter of a semester or session if they secure the approval of their adviser, the instructor of the course, and the dean of their school; a grade of W or F may be assigned by the instructor of the course. The grade so assigned is recorded on the final grade report. *Students will be allowed to withdraw from class during the last quarter of the semester only under extenuating circumstances. A written justification from a doctor, member of the clergy, adviser, etc., must be presented.* The necessary form for withdrawal from a course is available in the School of Science departmental offices and in the Office of the Associate Dean for Academic Programs and Student Development; Science, Engineering, and Technology III, Room 3224 [(317) 274-0626].

Students who alter their schedule, whether by personal incentive or by departmental directive, must follow withdrawal procedures. Students who do not follow these procedures risk jeopardizing their record by incurring a failing grade in a course not properly dropped, or they may risk not receiving credit for work done in a course that has not been properly added.

Incomplete The grade of I (Incomplete) indicates that the work is satisfactory as of the end of the semester but has not been completed. The grade of Incomplete may be given only when the student has completed three-fourths of the semester with course work of passing quality. Instructors may award the grade of Incomplete only upon a showing of such hardship to a student as would render it unjust to hold the student to the time limits previously fixed for the completion of the work.

Removal of Incomplete The removal of a grade of Incomplete is the responsibility of the student. A grade of Incomplete must be removed within one year from the time that it is given. An instructor has the option of designating a shorter time frame for removing the grade of Incomplete. An Incomplete grade that has not been removed by the end of one year will be converted by the Office of the Registrar to the grade of F. The dean may authorize adjustment of the one year period in exceptional circumstances.

FX Option The FX option is available only to undergraduate students and may be exercised for no more than three courses, totaling no more than 10 credit hours. By applying the FX option, a student who retakes a course previously failed shall have only the second grade in that course counted in the determination of the official transcript cumulative grade point average. The grade of FX is used to replace the original grade of F on the transcript and is not counted in computing the grade point average. A student may exercise the FX option no more than once for a given course. The student's transcript shall record all enrollments in the course and all grades earned for each enrollment, with an FX understood as reflecting an original grade of F.

In retaking the course, the student must receive a grade of A, B, C, D, S, or P to remove the original F grade. The designation W (Withdrawal) will not remove the original F unless the student is withdrawn from the original enrollment. Under this policy, a student may replace a grade through reenrollment only in a course in which a grade of F was received. A grade of D, C, or B cannot be improved by this policy. *Students who wish to take advantage of this option must secure the approval of the School of Science associate dean for academic programs and student development and fill out the FX form at the beginning of the semester in which the course is repeated.* The FX option form is available in the School of Science Office of the Associate Dean for Academic Programs and Student Development; Science, Engineering, and Technology III, Room 3224 [(317) 274-0626].

Courses Repeated

The School of Science computes a school grade point average, which is the basis for recommending the awarding of a degree. The computation of this grade point average, including repeated courses, is done during the senior year at IUPUI and is made using the rule that only the most recent grade in repeated courses counts in computing the school grade point average for the purpose of graduation. The official grade point average, which is based upon all grades earned, appears on all transcripts.

Credit by Examination and Special Credit

Students may receive course credit by examination or credit for credentials and/or experience. Departments within the School of Science authorize and determine such credits and administer the exams in their areas. The student must obtain a special credit form from the consenting department, obtain the necessary signatures, and pay the examination or special credit fee to the Office of the Bursar (see "Expenses and Financial Aid" in this bulletin). Credit earned by examination will be assigned an A (highest passing grade) or S (passing grade). Credit earned by credentials and/or experience will be assigned an S.

Course Audits

Auditing of courses is permitted under university policy, but audited courses may not be retaken at a later date for academic credit. Written permission from the instructor to audit a class must be obtained before the student attempts to register.

Petition for Grade Change

Faculty Petition A faculty member may request a change of grade for the student. This request can be honored only after approval of the department chairperson and the School of Science associate dean for academic programs and student development.

Student Petition In certain cases, a student may request a change of grade. Students should contact the School of Science Office of the Associate Dean for Academic Programs and Student Development (Science, Engineering, and Technology III, Room 3224) for information about procedures and time limits for applicable cases.

Class Standing

Class standing is based on the number of credit hours completed:

Freshman	0 to 25	Junior	56 to 85
Sophomore	26 to 55	Senior	86 or more

Change of Record

The necessary forms for changing information appearing on the student's permanent record regarding student address, school of enrollment, or major field of study are available in the School of Science Office of the Associate Dean for Academic Programs and Student Development (Science, Engineering, and Technology III, Room 3224) or in the IUPUI Office of the Registrar (Cavanaugh Hall 133).

Science Scholars List and Dean's Honor List

The School of Science recognizes exceptional academic performance prior to graduation from the university by periodically publishing the Science Scholars List and the Dean's Honor List. The Science Scholars List is a list of names of full-time or part-time students who have completed at least 26 credit hours of course work at IUPUI and who have a semester and cumulative GPA of at least 3.75. The Dean's Honor List contains the names of the students who have achieved a GPA of 3.5 or higher during a semester in which they carry 12 or more credit hours. Part-time students who are juniors or seniors and who have a cumulative and semester GPA of 3.5 or higher will also be included on the Dean's Honor List. Courses assigned a deferred grade (R) will count toward the 12 credit hours minimum required of full-time students. Courses taken on a Pass/Fail basis will not count toward the 12 credit hour minimum. Students who received an Incomplete (I) will not be placed on the Science Scholars List or the Dean's Honor List. Neither list is published for the summer sessions.

Candidates for Baccalaureate Degrees

Students are considered to be candidates in good standing for a baccalaureate degree awarded by the School of Science when they have been admitted as regular students by the Office of Admissions, their last semester's grade point average is not less than a 2.0, and their cumulative grade point average is not below this same level.

Double Major

A double major is awarded to students who simultaneously complete the requirements for two Purdue Bachelor of Science degree programs or two Purdue Bachelor of Arts degree programs in the School of Science. Students who plan to double major must have their programs approved by both major departments and the associate dean for academic programs and student development.

A form to petition for a double major can be obtained from the Office of the Associate Dean for Academic Programs and Student Development; School of Science; Science, Engineering, and Technology III, Room 3224 [(317) 274-0626]. A student declaring a double major must satisfy the departmental requirements for the second major as stated in the School of Science bulletin in effect when the second major is approved.

Double Degree

A student may be awarded two degrees by simultaneously completing baccalaureate degree programs from two different schools at IUPUI or by simultaneously completing two baccalaureate major programs from the School of Science, one leading to a Purdue Bachelor of Arts degree and the other leading to a Purdue Bachelor of Science degree, or one leading to a Purdue degree and the other leading to an Indiana University degree. A student who plans to pursue a double degree must receive approval from the two major departments and the academic deans of the schools awarding the degrees. A form to petition for a double degree can be obtained from the Office of the Associate Dean for Academic Programs and Student Development; School of Science; Science, Engineering, and Technology III, Room 3224 [(317) 274-0626]. A student who declares a double degree and who is accepted by a department in the School of Science for the additional degree program must satisfy the requirements for that program as stated in the School of Science bulletin in effect when the additional degree program is approved.

Second Baccalaureate Degree

Normally the holder of a baccalaureate degree who wishes to pursue a further educational goal is encouraged to become qualified for admission to a graduate degree program. In certain cases, however, the associate dean for academic programs and student development of the School of Science may admit a student who has earned a baccalaureate degree to candidacy for a second baccalaureate degree. The student should petition the dean for this privilege before beginning the program. If such admission is granted, the candidate must meet the requirements of the School of Science and of the department in which the student is a candidate. Completion of 32 credit hours of course work at the 300 level or above at IUPUI is required. This required course work is in addition to course work applied to any other undergraduate degree awarded at IUPUI.

Degrees Awarded with Distinction

IUPUI recognizes outstanding performance in course work of any student by awarding bachelor's degrees with distinction. Purdue degrees are awarded with Distinction and Highest Distinction. IU degrees are awarded with Distinction, High Distinction, and Highest Distinction. To be eligible a student must have taken a minimum of 60 credit hours at IUPUI.

GPA	Purdue	IU
3.5500-3.7499	Distinction	Distinction
3.7500-3.8499	Highest Distinction	High Distinction
3.8500-4.0000		Highest Distinction

Academic Standing

Academic Probation

Students are on academic probation when either their semester grade point average or cumulative grade point average is below 2.0. Each student on academic probation will be so advised by letter from the associate dean for academic programs and student development.

Dismissal

Students are dismissed from the university when, in the opinion of the associate dean for academic programs and student development of the School of Science, they have ceased to make progress toward their degree.

Students are subject to dismissal when they have failed to attain a grade point average of 2.0 in any two consecutive semesters and when their cumulative grade point average is below 2.0.

Students placed on the academic probation list or dismissal list will be so advised by letter from the associate dean for academic programs and student development. Summer sessions are excluded in the determination of academic probation or dismissal.

Readmission

A student dismissed for the first time must remain out of school at least one regular (fall, spring) semester. During the semester out of school, the student may petition the Office of the Dean for Academic Programs and Student Development for readmission. A student dismissed for the

second time must remain out of school at least two regular semesters, but may submit a petition for readmission during the second semester out of school.

In order that petitions for readmission have sufficient time for consideration, students eligible to submit them should do so before June 15 for the fall semester, October 15 for the spring semester, and March 15 for the summer sessions.

Students who are readmitted will be so informed by letter from the associate dean for academic programs and student development. They are informed of conditions and restrictions upon which readmission depends.

Special Facilities and Services

Libraries

The IUPUI library system is composed of five separate libraries that are open to all students enrolled at the university. These are located at the dental school, Herron School of Art, University Library, law school, and medical school. The School of Physical Education maintains a reference room of professional physical education materials, and the School of Education maintains a Curriculum Center. The dental, Herron, law, and medical libraries contain specialized collections reflecting their respective curricula. The collection at the University Library covers a wide range of academic disciplines from the liberal arts to science, engineering, and technology. In addition, it offers online database searching and abstracts and indexes on CD ROM. Specialized collections on artificial intelligence, robotics, CAD/CAM, acid rain, and NASA reports are available on microfiche. Since lending policies and procedures vary slightly among the different libraries, students should consult with personnel at the main desk of each library before checking out books and other materials.

Office of Integrated Technologies

A *Student Guide to Integrated Technologies* details useful information for students regarding services available on the campus through the Office of Integrated Technologies. This guide is available in Engineering and Technology 1021, and contains information about the following services.

Public technology clusters contain both IBM and Macintosh computers and give students access to mainframe computers as well as to microcomputer word processing, spreadsheet, and database programs. Consultants are available in the clusters for help in using the systems, resolving problems, and using the cluster software.

The **Integrated Technology Center,** located in Cavanaugh Hall 421, contains media-equipped study carrels for students, faculty, and staff. The equipment includes audio, video, synchronous sound-slide, and related items. The center houses lecture and language tapes for use on the premises. The center is open during working hours on weekdays with evening hours Monday through Thursday as well as Saturday hours.

Students may apply for their own user ID that will allow them to use **electronic mail** for as long as they are at IUPUI. Request forms are available in Engineering and Technology 1023 and 1030.

Free technology classes offered under the TIPS program ("today's information processing skills") help students learn the basics of using DOS, word processing on the Macintosh or IBM, electronic mail, and database or spreadsheet programs, as well as the library and student services systems. Students may enroll in TIPS classes in Engineering and Technology 1023 from 8 a.m. to 5 p.m., Monday through Friday.

Quick Docs, free handouts on the basics of technology, are available at the general consulting office in Engineering and Technology 1030. A list of all the Quick Docs is posted in each cluster.

Access Point is a membership organization available to all students, faculty, and staff. Access Point functions as a microcomputer resource center and provides members with a variety of services: laser printing, graphics and text scanning, public domain software libraries, evaluation copies of commercial software packages, demonstration computers, purchasing plans, and assistance with computer system selection. Students are welcome to join for a nominal fee of $15 per year. Access Point is located in Engineering and Technology 1030D.

The **Instructional Technology Services Center,** located in Cavanaugh Hall 421 [(317) 274-4510], serves as the coordination center for audiovisual services for faculty and students. Students may

purchase a course audio for a nominal fee. They may also arrange to use audiovisual equipment for a course presentation with an instructor's approval. The center has both daytime and evening hours.

Production services, including video and audio production, photography services, photo lab processing, and preparation of graphics are also available. These services are available only to individual students or student groups when prior approval has been obtained from the Office of Student Activities, University Library 002E [(317) 274-3931].

Special Programs

Teacher's Certificate

A student earning a baccalaureate degree in the School of Science may also receive a standard senior high/junior high/middle school teacher's certificate. The standard certificate qualifies the holder to teach in the subject matter areas for which it is endorsed in any public middle school, junior high school, or secondary school in Indiana. The standard certificate is granted upon completion of a baccalaureate degree based on a program of teacher education and the recommendation of the graduating institution. It is valid for five years from the completion of program requirements and may be renewed.

Students who plan to obtain a teaching certificate must be admitted formally to the Teacher Education Program. Admission to teacher education is dependent on successful completion of an admission test and course prerequisites listed in the School of Education Undergraduate Program Bulletin. Application forms and test information are available from the student's departmental adviser or from the School of Education, 902 W. New York Street, Indianapolis, IN 46202-5155.

A candidate for a senior high/junior high/middle school teacher's certificate *and* a bachelor's degree must satisfy the appropriate degree requirements of the IUPUI School of Science, the departmental requirements, and the School of Education certification requirements. The student must, therefore, plan a complete program with a School of Science adviser and a School of Education adviser to ensure that all requirements are satisfied.

A candidate for a senior high/junior high/middle school teacher's certificate must earn a baccalaureate degree that includes 124 credit hours. The student must have a grade point average of 2.5 or above in all university work taken. The student must earn a grade point average of 2.5 in all education courses (with at least a C in each methods course), and a grade point average of 2.5 in all the course work of the teaching major and of the teaching minor if one exists.

For a standard certificate, the state of Indiana sets the following general education, professional education, and subject matter area requirements:

General Education (40 cr.)

Humanities: a minimum of 18 credit hours chosen from, for example, English, fine arts, folklore, foreign language, music, philosophy, speech, and theater.
Social and Behavioral Sciences: a minimum of 9 credit hours chosen from, for example, anthropology, economics, geography, history, political science, psychology, and sociology.
Life and Physical Sciences: a minimum of 9 credit hours—subject matter area meets this requirement; some departments specify lab sciences.
Electives as needed for a total of 40 credit hours.

Professional Education (31 cr.)

EDUC P255 Educational Psychology for Middle and Secondary School Teachers (3 cr.) *and* EDUC M201 Laboratory/Field Experience (1 cr.)
EDUC W200 Microcomputing for Education (1 cr.)
EDUC H340 Education and American Culture (3 cr.)
EDUC M300 Teaching in a Pluralistic Society (3 cr.)
EDUC M314 Teaching Methods for Senior High/Junior High/Middle School Teachers (3 cr.) *and* EDUC M301 Laboratory/Field Experience (0 cr.)
EDUC M464 Methods of Teaching Reading (3 cr.) *and* EDUC M401 Laboratory/Field Experience (0 cr.)
EDUC M440-M478 Methods of Teaching (major academic area) (4 cr.)
Student Teaching: Junior High/Middle School/Secondary (16 cr.)

Note: Admission to the Teacher Education Program is a prerequisite for the three 400-level education courses.

All methods courses must be completed before a student may enroll in the EDUC M480 and EDUC M451 student teaching courses. During the semester of student teaching, the student normally does not enroll in other courses.

All science teaching programs must include courses in nutrition and drug and alcohol education.

Consult a School of Education adviser about any changes in or additions to these requirements.

Predental and Premedical Programs

Admission to dental and medical schools is highly competitive. The preprofessional student is therefore urged to elect a degree program, rather than to strive for the minimal requirements of these schools. Preprofessional counseling is available from advisers in the Departments of Biology and Chemistry, which also offer preprofessional degree programs. Advisers help students prepare for the professional school admissions process. They can also suggest alternative, rewarding career opportunities should the application to the professional school be unsuccessful. Graduate students holding nonscience degrees who are electing courses in the School of Science to prepare for professional school are also invited to use this advising service.

Honors Program

The IUPUI Honors Program is open to students in both the Purdue and Indiana University degree programs. Students with a 3.3 overall grade point average after their first full semester of work, entering freshmen with a combined SAT score of 1200, or those who graduated in the top 10 percent of their high school class are invited to participate in the Honors Program. Students with less than a 3.3 grade point average may be permitted to take honors courses. They should, however, discuss the matter with their academic adviser and the honors adviser before doing so.

To obtain an honors degree in all departments in the School of Science, except geology and psychology, a student must have a cumulative grade point average of 3.3 and a minimum of 24 credit hours, with a 3.5 grade point average in honors work. Six hours of honors credit must be outside the student's major field. Students majoring in geology or psychology should follow the requirements below since these departments have their own requirements.

Geology

For the Bachelor of Science degree, the student must complete 24 credit hours of honors work, 18 in geology and 6 in other approved honors courses. For the Bachelor of Arts degree, the requirements are 15 credit hours in geology and 9 credit hours outside geology in other approved honors courses. The following upper-division geology courses are approved for H-Option contracts[1]: G323 Structural Geology; G334 Principles of Sedimentation and Stratigraphy; G403 Optical Mineralogy and Petrography; G404 Geobiology (3 cr.) plus G410 Undergraduate Research in Geology (1 cr.); G406 Introduction to Geochemistry; G413 Introduction to Earth Physics; G415 Principles of Geomorphology; G416 Economic Geology; G430 Principles of Hydrology; G499 Honors Research in Geology. The student must complete 3 credit hours in G499 Honors Research in Geology to satisfy the requirements for the honors component. The overall grade point average must be 3.3 with a 4.0 in all honors work.

Psychology

To graduate with honors, students may choose one of two tracks. *Track one:* The student must earn at least 24 hours of honors credit, 6 of which must be in psychology and 6 of which must be outside of psychology (the remaining 12 can be either). At least 3 hours of this credit must be for PSY B499 Honors Research, which should culminate in an honors thesis. *Track two:* The student must earn at least 21 hours of honors credit, 6 of which must be in psychology and 6 of which must be outside of psychology (the remaining hours can be from either). At least 6 hours of the credit must be for a research project culminating in a psychology thesis. In this track the university honors council must approve the project proposal. In both tracks only grades of A or B will count for honors credit. To graduate with honors, the student must have an overall GPA of 3.3 with at least a GPA of 3.5 in honors and psychology courses.

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[1]H-Options are the most popular and frequent way that students earn honors credit. An H-Option requires that a student work out with the instructor of a course a specific contract for a paper, field project, oral presentation, etc., early in the semester. All the necessary signatures of approval, including that of the director of the Honors Program, must be submitted to the Honors Program office before consent to begin research will be given.

In general, students may take no more than 6 credit hours of honors work a semester. Students may earn honors credit by taking special honors courses (H300, H399, H400), by taking specially designated sections of multisection courses, by doing special overseas or internship work, or by contracting for honors credit using an H-Option contract[1] in conjunction with regular classes.

Students completing honors work or an honors degree will, upon request, receive an honors course record, listing all honors work, to be included with official university grade transcripts.

For additional information, contact the Honors Program, Education/Social Work Building 2126, 902 W. New York Street, IUPUI, Indianapolis, IN 46202-5154 [(317) 274-2314].

Cooperative Education Program

The School of Science Internship and Cooperative Education Program gives science students the opportunity to gain professional work experience in a supervised setting while studying for degrees. The program is currently available in only select situations.

A student should apply directly to the cooperative education coordinator within the student's department for information and specifics of program implementation or contact the Professional Practice Program, Office of Career and Employment Services, Business/SPEA Building 2010, 801 W. Michigan Street, IUPUI, Indianapolis, IN 46202-5153 [(317) 274-2554].

Officer Training Program (ROTC)

The U.S. Army Reserve Officers' Training Corps (ROTC) program is available for all students. Four-, three-, and two-year scholarships are awarded on a competitive basis. Scholarships will cover tuition, laboratory, graduation, and educational fees, and will provide $390 annually for out-of-pocket expenses as well as a tax-free grant of $1,000 for each year of scholarship. Students may enroll in the ROTC program on a voluntary or exploratory basis during the first two years. Books and supplies are provided, tuition is free, and elective credit hours are awarded for the freshman and sophomore military science classes. Students do not incur any military commitment until enrollment in the third-year course or upon acceptance of an ROTC scholarship. Advance placement in military science is available for veterans, members of the Army Reserve or National Guard, and students with three to four years of high school ROTC. Nonscholarship students taking advanced ROTC courses will receive a tax-free living allowance of $2,000. Students who are members of the Army Reserve or National Guard can become ROTC cadets and receive benefits from the two programs. Completion of the program leads to commission as a second lieutenant in either the active army, Army Reserve, or National Guard. For further information call (317) 274-2691.

Distinguished Faculty Awards

The School of Science proudly salutes faculty members who have distinguished themselves in the areas of teaching, research, or service. The following full-time faculty members have been chosen by their colleagues and students to receive awards in recognition of their outstanding contributions to the academic mission of the School of Science and the university.

H. David Laverell	1975	Frederick Thatcher	1982
L. Kent Morrison	1976	Erwin Boschmann	1983
Gordon H. Fricke	1977	Robert D. Hall	1983
Erwin Boschmann	1978	David Malik	1983
Frederick W. Kleinhans	1978	Martin O'Donnell	1983
Terry L. Hall	1979	Stanley Aeschleman	1984
Robert D. Hall	1980	Elaine V. Alton	1984
John F. Kremer	1980	Patricia A. Boaz	1984
Patricia A. Boaz	1981	Marvin Kemple	1984
Martin O'Donnell	1981	John F. Kremer	1984
Forrest T. Meiere	1982	B. D. Nageswara Rao	1984
Peter W. Rabideau	1982	Richard Bodonyi	1985

[1]H-Options are the most popular and frequent way that students earn honors credit. An H-Option requires that a student work out with the instructor of a course a specific contract for a paper, field project, oral presentation, etc., early in the semester. All the necessary signatures of approval, including that of the director of the Honors Program, must be submitted to the Honors Program office before consent to begin research will be given.

Frederick W. Kleinhans	1985
Richard Pflanzer	1985
Arthur Mirsky	1985
D. W. Rajecki	1985
J. Roger Ware	1985
Shirley Bayer	1986
Joan Lauer	1986
J. Roger Ware	1986
C. D. Aliprantis	1987
Owen Burkinshaw	1987
Judith Gersting	1987
John F. Kremer (two awards)	1987
Richard Patterson	1987
J. Roger Ware	1987
Theodore Cutshall	1988
Pascal de Caprariis	1988
Robert D. Hall	1988
Charles Schauf	1988
John Gersting	1989
Raima Larter	1989
C. D. Aliprantis	1989
Florence Juillerat	1989
Rosalie Bandy*	1989
Gregor Novak	1990
Kenneth Lipkowitz	1990
Richard Wyma	1990
Arthur Mirsky	1990
Florence Juillerat	1990
David Malik	1990
Richard O. McCracken	1991
Gary Bond	1991
Gregory Novak	1991
Forrest Meiere	1991
Rosalie Bandy*	1991
Florence L. Juillerat (two awards)	1992
Jerome Kaminker	1992
Kathryn Wilson	1992
Gordon Fricke	1992
Kenneth Lipkowitz	1992

Introducing recombinant DNA into E. coli *in a genetics lab.*

*Professional Staff Member

Department of Biology

Professors Bard, Bayer, Keck, Ockerse, Stocum (Dean)

Associate Professors Chernoff, Jenski, Juillerat, Lees (*Chairperson*), McCracken (*Associate Chairperson*), Pflanzer, Russo, Stillwell, Wilson, Witzmann (IUPUI Columbus)

Assistant Professors Clack (IUPUI Columbus), Crowell, Randall

Adjunct Professors Chandrasekhar, Hengst, Ingolia, McIntyre, Petersen, Schoepp, Smith, Zuckerman

Departmental Academic Advisers *Preprofessional:* Ockerse; *Prepharmacy and Preoptometry:* Lees; *Preveterinary:* McCracken; *Biology programs:* All faculty; *Graduate programs:* Lees

The Department of Biology offers undergraduate instructional programs leading to the Bachelor of Arts (B.A.) and Bachelor of Science (B.S.) degrees. These programs are designed to prepare students for a variety of careers in the biological sciences and allow sufficient flexibility to accommodate the needs and interests of students. Postgraduate activities frequently selected by our biology majors include graduate schools, medical and dental schools, other health care professions, agricultural schools, industrial positions in research and technology, and secondary teaching. The selection of a particular degree program in biology should be made in consultation with a departmental adviser.

The Department of Biology offers graduate study leading to the Master of Science (M.S.) degree. The M.S. degree program may be completed with a thesis option or with a nonthesis option in interdisciplinary biology. Among the nonthesis options is the M.S. degree in the teaching of biology, which is designed primarily for secondary school teachers. Within the thesis option are the M.S. in biotechnology, which is designed to provide classroom and research experience in a variety of applied disciplines, and the Industrial Co-op Program, which includes research in one of several industries in the Indianapolis area.

The degree of Doctor of Philosophy (Ph.D.) can be pursued in the Department of Biology in a variety of areas, where programs have been arranged with Purdue, West Lafayette. The Ph.D. program comprises formal courses, guided individual study, and original research culminating in a scholarly thesis. Ph.D. degrees through Indiana University may be pursued with faculty who hold appointments with programs and departments in the Indiana University School of Medicine.

The Department of Biology regards research as an important component of its programs at both the undergraduate and graduate levels. Students may work in such specific areas as microbial genetics, membrane biochemistry and biophysics, immunology, parasitology, neuroanatomy, morphogenesis and ultrastructure of plants, recombinant DNA, cell biology, microbiology, neuroethology, and plant and animal tissue culture.

Bachelor of Arts

Degree Requirements

Area I See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree" in this bulletin. The second semester of English composition may be satisfied with ENG W132 (or ENG W150), ENG W231, or TCM 320.

Area II There is no foreign language requirement; however, knowledge of a foreign language is strongly recommended for any student planning to attend graduate school.

Areas IIIA and IIIB See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree" in this bulletin.

Area IIIC Physical and Biological Sciences
Physics Two semesters of basic physics (PHYS P201-P202 or PHYS 152-251).
Chemistry Through two semesters of organic chemistry lecture and one semester of laboratory (CHEM C341, C342, C343), plus prerequisite basic sequence or background to enter sequence above. Basic chemistry sequence to be worked out with departmental adviser based on SAT scores and/or background of the student. The second laboratory in organic chemistry (CHEM C344) is required for admission to some medical schools and is strongly recommended for students in most other programs—consult a departmental adviser.

Area IIID Mathematical Sciences MATH 151. The starting point to be worked out with departmental adviser based on the math placement test and/or background of the student. The computer requirement may be satisfied with CSCI 206, CSCI 207, or CSCI 220.

Area IV Biology Requirements

Required Core Sequence:

K101-K103 (Concepts of Biology I and II)
K322 (genetics lecture)
K341 (ecology lecture)

Upper-Level Courses

A. At least one lecture course from each of areas I-III listed below.
B. Three laboratory courses beyond K101-K103 selected from areas I-IV below. A maximum of 2 credit hours of K493 Independent Research may be applied to the biology credit hour requirement. K493 will count as one laboratory course.
C. Electives—consisting of sufficient lecture and laboratory course work to total 30 credit hours (including core sequence credit hours). These credits may be selected from any of the areas I-IV below.

Areas/Electives

I. Molecular Area
Undergraduate Level
K338 Introductory Immunology
K339 Immunology Laboratory
K483 Biological Chemistry
K484 Cellular Biochemistry
Undergraduate and Graduate Level
507 Principles of Molecular Biology
530 Introductory Virology
561 Immunology
570 Biological Membranes
583 Biological Regulation
651 Cellular Immunology

II. Cellular Area
Undergraduate Level
K356 Microbiology
K357 Microbiology Laboratory
Undergraduate and Graduate Level
501 Cell Physiology
532 Topics in Bacteriology
566 Developmental Biology
567 Laboratory in Developmental Biology
571 Developmental Neurobiology

III. Organismal Area
Undergraduate Level
K331 Embryology
K332 Plant Growth and Development
Undergraduate and Graduate Level
556 Physiology I
557 Physiology II

IV. Biotechnology Electives
Undergraduate Level
K309 Computer Applications in Biology and Medicine
K493 Independent Research
Undergraduate and Graduate Level
540 Topics in Biotechnology
548 Techniques in Biotechnology

Additional laboratory courses for the B.A.
K323 Genetics Laboratory
K342 Ecology Laboratory

The Department of Biology will accept 20 credit hours toward graduation outside the Schools of Science and Liberal Arts. A maximum of 15 credit hours of biology earned at other institutions is applicable toward the major for the B.A. degree.

Bachelor of Science

Degree Requirements

Area I See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree" in this bulletin. The second semester of English composition may be satisfied with ENG W132 (or ENG W150), ENG W231, or TCM 320.

Area II There is no foreign language requirement; however, knowledge of a foreign language is strongly recommended for any student planning to attend graduate school.

Areas IIIA and IIIB See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree," in this bulletin.

Area IIIC Physical and Biological Sciences
Physics Two semesters of basic physics (PHYS P201-P202 or PHYS 152-251).
Chemistry Through two semesters of organic chemistry with laboratory (CHEM C341, C342, C343, C344), plus prerequisite basic sequence or background to enter sequence above. Basic chemistry sequence to be worked out with departmental adviser based on SAT scores and/or background of the student. (A course in analytical chemistry or biochemistry is also strongly recommended—determination to be made in consultation with departmental adviser.)

Area IIID Mathematical Sciences Course work through two semesters of calculus (MATH 221-222 or MATH 163-164). Starting point to be worked out with departmental adviser based on the math placement test and/or background of the student. The computer requirement may be satisfied with CSCI 206, CSCI 207, or CSCI 220.

Area IV Biology Requirements
Required Core Sequence:
K101-K103 (Concepts of Biology I and II)
K322, K323 (Genetics with laboratory)
K341, K342 (Ecology with laboratory)
K493 (Independent Research; 2 cr. min., 3 cr. max.)
K494 (Senior Research Thesis)

Upper-Level Courses
A. At least one course from each of areas I-III listed below.
B. Two laboratory courses beyond the core sequence laboratories selected from areas I-IV.
C. K494 Senior Research Thesis. This will consist of the completion of K493 activities and the preparation of a written report on the results of the research project. The title and nature of the K493-K494 sequence is to be determined in consultation with the department research sponsor.
D. Electives consisting of sufficient lecture and laboratory course work to total 40 credit hours (including core sequence credit hours). These credits may be selected from any of the areas I-IV below.

Areas/Electives
I. Molecular Area
Undergraduate Level
K338 Introductory Immunology
K339 Immunology Laboratory
K483 Biological Chemistry
K484 Cellular Biochemistry
Undergraduate and Graduate Level
507 Principles of Molecular Biology
530 Introductory Virology
561 Immunology
570 Biological Membranes
583 Biological Regulation
651 Cellular Immunology
II. Cellular Area
Undergraduate Level
K356 Microbiology
K357 Microbiology Laboratory

Undergraduate and Graduate Level
501 Cell Physiology
532 Topics in Bacteriology
566 Developmental Biology
567 Laboratory in Developmental Biology
571 Developmental Neurobiology

III. Organismal Area
Undergraduate Level
K331 Embryology
K332 Plant Growth and Development
K443 Medical Parasitology and Entomology
Undergraduate and Graduate Level
556 Physiology I
557 Physiology II

IV. Biotechnology Electives
Undergraduate Level
K309 Computer Applications in Biology and Medicine
K493 Independent Research
Undergraduate and Graduate Level
540 Topics in Biotechnology
548 Techniques in Biotechnology
565 Laboratory in Immunology

The Department of Biology will accept 20 credit hours toward graduation outside the Schools of Science and Liberal Arts. A maximum of 20 credit hours of biology earned at other institutions is applicable toward the major for the B.S. degree.

Minor in Biology

The Department of Biology offers a minor in biology with the following requirements:
BIOL K101 Concepts of Biology I—Plants (5 cr.)
BIOL K103 Concepts of Biology II—Animals (5 cr.)
BIOL K322 Genetics (3 cr.)
BIOL K341 Principles of Ecology (3 cr.)
Additional K-prefixed biology course of at least 3 credits

At least half of the minimum 19 credit hours required to minor in biology must be completed at IUPUI. The minor requires a minimum grade point average of 2.0 and all grades must be C- or better. Correspondence courses may not be used to fulfill requirements for the minor.

Biology Plans of Study

There is no single semester-by-semester plan of study for any of the degree options because of the flexibility encouraged within the program for each option. However, one possible sequence of courses for each option is given below; variations from these examples of plans of study should be made in consultation with a departmental adviser.

Bachelor of Arts Sample Program (124 cr.)

Freshman Year

First Semester		**Second Semester**	
BIOL K101 Concepts of Biology I—Plants	5	**BIOL K103** Concepts of Biology II—Animals	5
CHEM C105 Principles of Chemistry I	5	**CHEM C106** Principles of Chemistry II	5
ENG W131 Elementary Composition I	3	**MATH 154** Algebra and Trigonometry II	3
MATH 153 Algebra and Trigonometry I	3	Second Composition Course	3
	16		16

Sophomore Year

Third Semester
BIOL K341 Principles of Ecology 3
BIOL K342 Ecology Laboratory 2
CHEM C341 Organic Chemistry I 3
CHEM C343 Organic Chemistry Laboratory I 2
COMM C110 Fundamentals of Speech Communication 3
Arts and Humanities Elective 3
16

Fourth Semester
BIOL K331 Embryology 4
CHEM C342 Organic Chemistry II 3
CHEM C344 Organic Chemistry Laboratory II (optional) 2
Social and Behavioral Sciences Elective 3
Elective 3
15

Junior Year

Fifth Semester
BIOL K322 Genetics 3
BIOL K323 Genetics Laboratory 2
PHYS P202 General Physics I 5
Arts and Humanities Elective 3
Social and Behavioral Sciences Elective 3
16

Sixth Semester
BIOL K356 Microbiology 3
PHYS P202 General Physics II 5
Social and Behavioral Sciences Elective 3
Elective 3
14

Senior Year

Seventh Semester
BIOL K483 Biological Chemistry 3
CSCI 206 Computer Programming *or*
CSCI 207 Computers in the Social Sciences *or*
CSCI 220 Problem Solving with Computers 3
Arts and Humanities Elective 3
Electives 7
16

Eighth Semester
Arts and Humanities Elective 3
Electives 12
15

Bachelor of Science Sample Program (124 cr.)

Freshman Year

First Semester
BIOL K101 Concepts of Biology I—Plants 5
CHEM C105 Principles of Chemistry I 5
ENG W131 Elementary Composition I 3
MATH 221 Calculus for Technology I 3
16

Second Semester
BIOL K103 Concepts of Biology II—Animals 5
CHEM C106 Principles of Chemistry II 5
MATH 222 Calculus for Technology II 3
Second Composition Course 3
16

Sophomore Year

Third Semester
BIOL K341 Principles of Ecology 3
BIOL K342 Ecology Laboratory 2
CHEM C341 Organic Chemistry I 3
CHEM C343 Organic Chemistry Laboratory I 2
COMM C110 Fundamentals of Speech Communication 3
Arts and Humanities Elective 3
16

Fourth Semester
BIOL K331 Embryology 3
CHEM C342 Organic Chemistry II 3
CHEM C344 Organic Chemistry Laboratory II 2
Social and Behavioral Sciences Elective 3
CSCI 206 Computer Programming *or*
CSCI 207 Computers in the Social Sciences *or*
CSCI 220 Problem Solving with Computers 3
14

Junior Year

Fifth Semester		Sixth Semester	
BIOL K322 Genetics	3	**BIOL K356** Microbiology	3
BIOL K323 Genetics Laboratory	2	**BIOL K357** Microbiology Laboratory	2
PHYS P201 General Physics I	5	**BIOL K493** Independent Research	1
Arts and Humanities Elective	3	**PHYS P202** General Physics II	5
Elective	3	Elective	3
	16		14

Senior Year

Seventh Semester		Eighth Semester	
BIOL K483 Biological Chemistry	3	**BIOL K494** Senior Thesis	1
BIOL K493 Independent Research	1	**BIOL** Elective	3
BIOL Elective	2	Social and Behavioral Sciences Elective	3
Electives	10	Electives	9
	16		16

Master of Science

Degree Options

M.S. Nonthesis in Interdisciplinary Biology This program requires 21 credit hours in biology, including a creative project to be defined in consultation with the graduate advisory committee, and 9 credit hours in a supporting secondary area. Secondary areas may be chosen from a wide variety of subjects that relate to the student's career objective or interest. Examples would include, but not be limited to, chemistry, mathematics, public affairs, business, statistics, law, computer science, and health administration. The M.S. degree in the teaching of biology is conferred when the supporting area is education. Primary area courses for the M.S. Nonthesis in Interdisciplinary Biology program must include BIOL 540 Topics in Biotechnology (3 cr.) and at least one course from each of the following areas: concepts of metabolism, concepts of homeostasis, and continuity of life. In addition, a creative project (BIOL 595 Special Assignments, 3 cr.) *must* be taken. The topic and nature of the project will be determined in consultation with the student's graduate adviser.

Course Areas in Interdisciplinary Biology

I. Concepts of Metabolism
   - 501 Cell Physiology
   - 507 Principles of Molecular Biology
   - 530 Introductory Virology
   - 532 Topics in Bacteriology
   - 548 Techniques in Biotechnology
   - 697 Special Topics (where appropriate)

II. Concepts of Homeostasis
   - 548 Techniques in Biotechnology
   - 556 General and Comparative Physiology
   - 557 Mammalian Systemic Physiology
   - 561 Immunology
   - 570 Biological Membranes
   - 583 Biological Regulation
   - 651 Cellular Immunology
   - 697 Special Topics (where appropriate)

III. Continuity of Life
   - 566 Developmental Biology
   - 567 Laboratory in Developmental Biology
   - 571 Developmental Neurobiology
   - 641 Microbial Genetics
   - 697 Special Topics (where appropriate)

M.S. with Thesis This program requires a minimum of 9 credit hours of 500–600-level course work in biology, chosen in consultation with the student's graduate committee, and intensive research leading to a thesis. Within the thesis program is a focused program in biotechnology.

There are five areas in biotechnology where course and research experiences are available. They are recombinant DNA, protein chemistry, tissue culture, immunology, and biomembrane technology. Minimum course work requirements include BIOL 540 Topics in Biotechnology (3 cr.), 3 credit hours from the research biotechnology area, and 3 credit hours from a secondary biotechnology area.

Course Areas in Biotechnology

I. Recombinant DNA
   507 Principles of Molecular Biology
   530 Introductory Virology
   532 Topics in Bacteriology
   641 Microbial Genetics
II. Protein Chemistry
   697 Special Topics (where appropriate)
III. Tissue Culture
   697 Topics in Tissue Culture
IV. Immunology
   561 Immunology
   651 Cellular Immunology
   697 Topics in Immunology
V. Biomembrane Technology
   570 Biological Membranes

M.S. Industrial Co-op Program The combined effort of the Purdue University School of Science at Indianapolis, IUPUI, and the industrial community of Indianapolis affords a unique opportunity to quality students seeking graduate work in biology. The M.S. Industrial Co-op Program normally requires 24 months (4 semesters) of full-time study, leading to a Purdue M.S. degree in biology. Students are encouraged to inquire about those firms currently participating and the specific research areas available since these may change from time to time. All academic requirements are identical to the normal Purdue M.S. with thesis option. The program includes laboratory research, seminars, and graduate biology courses in the areas specified under the previous section, "M.S. with Thesis." In this program, students are vital members of local industrial research groups during the co-op period.

To be eligible for the co-op program students must first meet the usual admission requirements for the M.S. with thesis option. During the first semester of graduate work, students will interview with local industry, and co-op assignments will be made by the graduate adviser and the industrial representatives. If a mutually satisfactory position cannot be found for a particular student, the student will be able to continue in the department's normal M.S. program. Neither students nor employers have a commitment for continued employment at the end of the students' program. However, the program allows close contact between students and employers and serves as an excellent basis for career decisions.

Admission Requirements

1. Students must hold a baccalaureate degree from an accredited institution of higher learning and demonstrate good preparation in the following subjects:
   biological sciences
   organic chemistry
   physics
   mathematics
2. Students must take the GRE aptitude tests.
3. Three letters of recommendation are required.
4. A minimum graduation grade point average of 3.0 or its equivalent is required for unconditional admission.

Transfer of Credit

Transfer credit to be used in the nonthesis option may be given for up to 9 credit hours of graduate work completed elsewhere with a grade of B or better. Such credit may be used only in the secondary area and will be accepted only after one semester of satisfactory work is completed in residence at IUPUI. Transfer credit is not accepted in the thesis option. Up to 12 hours of biology graduate credit taken at IUPUI under graduate nondegree status may be transferred to the thesis or nonthesis options.

Grades

Only grades of A, B, or C are acceptable, although performance higher than C may be required. Pass/Fail grades are unacceptable.

Requirements

Residence Requirements

Thirty credit hours of registration are required for the M.S. degree. Students entering with advanced standing from another graduate school are given residence credit commensurate with the graduate work accomplished.

Final Examination

A comprehensive written or oral examination in the individual's primary area may be required of nonthesis students unless their cumulative GPA is 3.0 or higher. The final examination for thesis students will consist of a thesis defense, which will be done in conjunction with BIOL 696 Seminar.

All students are required to take BIOL 696 Seminar. The creative project required of all nonthesis students will provide the basis for the public presentation.

Financial Assistance

The Department of Biology has financial support available in the form of tuition-refund assistantships, associate faculty positions, fellowships, and stipends from local industry on a limited basis.

Doctor of Philosophy—Purdue University

The degree of Doctor of Philosophy (Ph.D.), the highest earned degree conferred by Purdue University, can be pursued in the Department of Biology in areas where programs have been arranged with Purdue, West Lafayette. The doctoral degree is restricted to those scholars who have demonstrated superior ability in a recognized academic discipline. The Ph.D. degree is not awarded on the basis of time spent in residence or following the completion of any specific number of formal courses, nor is the degree granted on the basis of miscellaneous course studies and research effort. The entire Ph.D. program must be rationally related, should be highly research oriented, and should culminate in a thesis of scholarly merit indicative of the candidate's ability to conduct original research in a recognized field of specialization.

Ph.D. programs are directed by professors who work in close association with selected graduate students. In practice, doctoral programs are composed of formal courses, guided individual study in a chosen field or discipline, study in such cognate subjects as may be required by the candidate's advisory committee, and original research that serves as the basis of a scholarly thesis.

As part of their graduate training, all Ph.D. candidates are expected to teach at least quarter time for one year.

Ninety credit hours of registration are required for the Ph.D. degree. Students entering with advanced standing from another graduate school are given residence credit commensurate with the graduate work accomplished.

Fields of Study

Ph.D. degrees are offered in most of the fields described for the M.S. degree. Until a major professor is named, a student is counseled by a temporary adviser. In order to help familiarize students with the department and to assist the student in the selection of a major professor, a series of laboratory rotations is available.

Admission and Qualifying Examination

To enter the Ph.D. program, a student must satisfy the admission requirements for the M.S. with thesis option and also take a qualifying examination in two areas at the end of the first year of graduate study. By the end of the second year, both must have been passed with a grade of B or better. The examination areas are as follows: (1) animal physiology, (2) biochemistry, (3) biophysics, (4) developmental and cell biology, (5) ecology, (6) population genetics and evolution, (7) genetics, (8) microbiology, (9) molecular biology, (10) neurobiology, (11) plant biology.

Plan of Study

Each prospective candidate for the doctoral degree, with the approval of the head of the Department of Biology, shall select a major professor from the department who will act as the chairperson of the student's advisory committee and who will direct the research. An advisory committee of five faculty members who have been approved to guide graduate students will then be appointed.

The plan of study shall include a primary area and related area or areas. The plan will be appropriate to meet the needs of the student in a chosen field as determined by the advisory committee. The Graduate School of Purdue University does not impose any minimum number of required course credit hours, but the plan shall specify the area or field of interest in which the student proposes to study and to conduct research. The plan will include the specific courses that the student is expected to complete, all specific course and language (if any) requirements, and 2 credit hours of BIOL 696 Seminar.

The plan of study must be approved by the department or school head, the school dean, and the dean of the Graduate School at West Lafayette. The Graduate School dean reserves the right to refer any or all plans of study to the Purdue Graduate Council for review and approval when deemed advisable. The Graduate Council has the final authority to supervise the quality of all graduate programs.

Preliminary Examination

After the student has completed most of the formal study to the satisfaction of the advisory committee and met any language requirement(s), the student becomes eligible to take the preliminary examinations. The results of these written and oral examinations will be reported to the Graduate School by the examining committee with an appropriate recommendation for the student's admission to candidacy, continued preparatory study, or discontinuation. The Graduate School dean reserves the right to appoint additional members to the preliminary examining committee. The dean must be informed of the date and place of the examination and the membership of the examining committee at least two weeks before the examination. No examining committee shall have fewer than three faculty members.

The written preliminary examination will be conducted by the examining committee. In some cases, parts of the examination may be delegated to certain other staff members, but the final responsibility for the examination rests with the student's examining committee.

If the student does not pass the preliminary examinations, at least one semester must elapse before reexamination is permitted. Should the preliminary examinations be failed twice, the student may not be given a third examination, except upon the recommendation of the examining committee and with *special approval* of the Graduate Council.

Ph.D. Thesis

After admission to candidacy, the candidate must devote at least two semesters to research before the final examination.

The special research carried on as part of the doctoral work is expected to make a definite contribution to the candidate's chosen field of knowledge—a contribution of sufficient importance to merit publication. Candidates must, therefore, prepare a thesis showing the results of their research.

After the research has been completed and the thesis written, the candidate shall be given a final examination in which the candidate defends the thesis and demonstrates to the examining committee all of the capabilities for which the Doctor of Philosophy degree is awarded. The examining committee shall consist of no fewer than four members. The dean of the Graduate School reserves the right to appoint additional committee members and must be informed of the place and time of the final examination at least two weeks in advance.

Doctor of Philosophy—Indiana University

The Ph.D. degree conferred by Indiana University can be pursued under the direction of faculty in the Department of Biology who hold adjunct appointments with departments or programs in the Indiana University School of Medicine. All Indiana University doctoral degrees require 90 credit hours of registration; specific course and examination requirements vary with the

department or program in which the student is enrolled. Contact the graduate program director in the Department of Biology for additional information.

Other Programs

Bachelor of Arts with Secondary Teaching Certification

Students planning to teach biology at the secondary school level usually enter the Bachelor of Arts degree program. Elective hours within this program will be used to satisfy the requirements of the School of Education and the state of Indiana. These requirements are currently under review and students should consult their adviser and an adviser from the School of Education.

Prepharmacy

Currently the prepharmacy program is designed to encompass one year at IUPUI followed by four years at Purdue University, West Lafayette. However, it is possible to complete two full years of credit prior to transfer. The prepharmacy program has also been designed to link with the School of Pharmacy at Butler University.

Prepharmacy Sample Program

Year One

First Semester	**Second Semester**
BIOL K101 Concepts of Biology I—Plants.....5	**BIOL K103** Concepts of Biology II—Animals.....5
CHEM C105 Principles of Chemistry I.....5	**CHEM C106** Principles of Chemistry II.....5
ENG W131 Elementary Composition I.....3	**ENG W132** Elementary Composition II 3
MATH 221 Calculus for Technology I.....3	**MATH 222** Calculus for Technology II 3

Years two through five: Transfer to the School of Pharmacy and Pharmacal Sciences, Purdue University, West Lafayette.

Preoptometry

This program is specifically designed for transfer to the professional program at Indiana University Bloomington. Typically, three preoptometry years are spent at IUPUI.

Preoptometry Program Requirements

Subject	**Minimum credit hours required**
Inorganic chemistry	8
Organic chemistry	3
English composition	2
Calculus	4
General physics	8
Psychology	
Introductory and above	4
Statistical techniques	3
Biology/Zoology	
Introductory	4
Comparative or human anatomy	4
Advanced	3
Arts and humanities	6
Social and behavioral sciences	6
Foreign language	6-8
Elective	as needed
	90 credit hours

Preveterinary Medicine

IUPUI offers an organized four-semester preveterinary curriculum for students who want to meet the requirements for admission to the Purdue University School of Veterinary Medicine. This curriculum also provides for a rigorous program in the biological and physical sciences that may be used as a basis for continued training in the Purdue University School of Agriculture should the degree of Bachelor of Science be desired.

The student who has successfully completed two or more years of preveterinary instruction at IUPUI is eligible to apply for admission to the School of Veterinary Medicine at Purdue University in West Lafayette. Admission to the School of Veterinary Medicine is highly competitive. Students are selected on the basis of college course work and grades, Graduate Record Exam scores (General Aptitude Test only), and the extent and nature of the applicant's experience with animals and practicing veterinarians. The selection committee is also concerned with the individual's level of motivation, degree of maturity, and general character.

The requirements for admission to the preveterinary curriculum are the same as those for other programs in the School of Agriculture.

Preveterinary Sample Program

Freshman Year

First Semester
BIOL K101 Concepts of Biology I—Plants.....5
CHEM C105 Principles of Chemistry I.....5
ENG W131 Elementary Composition I.....3
MATH 221 Calculus for Technology I.....3
16

Second Semester
BIOL K103 Concepts of Biology II—Animals.....5
CHEM C106 Principles of Chemistry II.....5
ENG W132 Elementary Composition II.....3
MATH 221 Calculus for Technology II.....3
16

Summer Sessions
Humanities and Social Science Electives.....6

Sophomore Year

Third Semester
BIOL K322 Genetics.....3
BIOL K323 Genetics Laboratory.....2
CHEM C341 Organic Chemistry I.....3
CHEM C343 Organic Chemistry Laboratory I.....2
PHYS P201 General Physics I.....5
15

Fourth Semester
CHEM C342 Organic Chemistry II[1].....3
CHEM C344 Organic Chemistry Laboratory II[1].....2
COMM C110 Fundamentals of Speech Communication.....3
PHYS P202 General Physics II.....5
STAT 301 Elementary Statistical Methods I.....3
16

Summer Sessions
Humanities and Social Science Electives.....6

Junior and Senior
Transfer to School of Veterinary Science and Medicine, Purdue University, West Lafayette campus.

Courses in Biology (BIOL)

All courses designed for the biology major are identified by the letter prefix K on the course number or have no prefix. All courses identified by the letter prefix N are primarily designed to serve students uncommitted to a degree in biology or students for whom these courses are normal to their curricular program (e.g., allied health).

Note: P—prerequisite; C—corequisite; R—recommended; Fall—offered fall semester; Spring—offered spring semester; Summer—offered during one or both of the summer sessions; Day—offered as a daytime section; Night—offered as an evening section; Equiv.—course is equivalent to the indicated course taught at Indiana University Bloomington, or the indicated course taught at Purdue University, West Lafayette.

[1]CHEM C310 Analytical Chemistry and CHEM C311 Analytical Chemistry Laboratory may be substituted for CHEM 342 and CHEM 344.

Undergraduate Level

K101 Concepts of Biology I—Plants (5 cr.) P: High school or college chemistry. Fall, day; Spring, day, night; Summer, day. An introductory course emphasizing the principles of cellular biology; molecular biology; genetics; and plant anatomy, diversity, development, and physiology.

K103 Concepts of Biology II—Animals (5 cr.) P: K101. Fall, day, night; Spring, day; Summer, day. An introductory biology course emphasizing structure, physiology, development, diversity, and behavior in animals, and evolution and ecology of plants and animals.

K295 Special Assignments (arr.) P: Consent of instructor. Fall, Spring. Special work, such as directed readings, laboratory or field work, or presentation of material not available in the formal courses in the department.

K309 Computer Applications in Biology and Medicine (3 cr.) P: Sophomore standing and one semester of biology. Spring, day. Provides the undergraduate with experience in the major applications of the computer to the life sciences. Topics: computer hardware, software, BASIC programming concepts, and application packages. Projects: micro and mainframe computer experiences with databases, simulations, statistical packages, computer graphics, networks, and computer interfacing to laboratory equipment.

K322 Genetics (3 cr.) P: K103, CHEM C106. Fall, day. Principles of genetics at the molecular, cellular, organismal, and population level.

K323 Genetics Laboratory (2 cr.) P or C: K322. Fall, day. Applied principles of genetics using organisms of increasing complexity, from viruses to the fruit fly.

K331 Embryology (4 cr.) P: K103. Spring, day. The development of animals through differentiation of cells, tissues, organs, and organ systems will be examined.

K332 Plant Growth and Development (3 cr.) P: K101, CHEM C341. Fall, day. An examination of growth and developmental patterns in plants as affected by growth regulators, age, heredity, photoperiod, and environmental factors.

K338 Introductory Immunology (3 cr.) P: K103, CHEM C106. Fall, day. Principles of basic immunology with an emphasis on the cells and molecules underlying immunological mechanisms.

K339 Immunology Laboratory (2 cr.) P or C: K338. Fall, day. Demonstration of immunological principles by experimentation. Exercises include cells and factors of the innate and the adaptive immune systems.

K341 Principles of Ecology (3 cr.) P: K103. Fall, day. A study of the basic concepts of the interrelation of living organisms and their environment.

K342 Ecology Laboratory (2 cr.) P or C: K341. Fall, day. Experiments in the laboratory and field to illustrate the principles and techniques of ecology.

K356 Microbiology (3 cr.) P: K103, CHEM C341. Spring, day, night. Introduction to microorganisms: cytology, nutrition, physiology, and genetics. Importance of microorganisms in applied fields including infectious disease.

K357 Microbiology Laboratory (2 cr.) P or C: K356. Spring, day. Laboratory experiments and demonstrations to yield proficiency in aseptic cultivation and utilization of microorganisms; experimental investigations of biological principles in relation to microorganisms.

K483 Biological Chemistry (3 cr.) P: CHEM C342. Fall, day. Chemistry of biologically important molecules including carbohydrates, lipids, proteins, and nucleic acids. Special emphasis on chemistry of intermediary metabolism.

K484 Cellular Biochemistry (3 cr.) P: CHEM C342, K483. Spring, day, night. Emphasis on selected topics in cellular biochemistry including nucleic acid : protein interactions, protein : protein interactions, protein synthesis, biogenesis of membranes, and signal transduction. Current techniques utilized to study these processes in higher eukaryotes will be discussed.

K493 Independent Research (1-3 cr.) P: Consent of instructor. Fall, Spring, Summer. A course designed to give undergraduate students majoring in biology an opportunity to do research in a field in which they have a special interest.

K494 Senior Research Thesis (1 cr.) P: K493. Fall, Spring, Summer. A formally written report describing the results or accomplishments of K493.

Undergraduate and Graduate Level

501 Cell Physiology (3 cr.) P: K103, CHEM C342. Spring, night. A study of cells at the physiological level, including the structure and function of organelles and membranes, enzymology, energy relationships and metabolic control, response to radiation, excitability and contractility, and the regulation of cell growth and differentiation.

507 Principles of Molecular Biology (3 cr.) P: K322, CHEM C342, or consent of instructor. Fall, night. Molecular aspects of structure and function of nucleic acids and proteins,

including recombinant DNA research. Prokaryotic and eukaryotic molecular biology are given equal weight.

530 Introductory Virology (3 cr.) P: K356, CHEM C342. Fall, odd years, night. Detection, titration, and chemistry of viruses. Viral host interactions: bacteriophage—bacterium, animal virus—animal cell, plant virus—plant cell. Tumor viruses: infection and transformation.

532 Topics in Bacteriology (2 cr.) P: K356 and CHEM C342. Fall, even years, night. Selected topics in bacterial physiology: cell division, chemotaxis, bacterial plasmids, sporulation, bacterial toxins, recombinant DNA.

540 Topics in Biotechnology (3 cr.) P: K322 and CHEM C341 or consent of instructor. Fall, night. Examines research techniques and applications for several technologies situated at currently recognized biological frontiers including recombinant DNA technology, hybridoma technology, protein engineering, agricultural research, and microbiological engineering.

548 Techniques in Biotechnology (3 cr.) P: K322, CHEM C342, or consent of instructor. Fall, day, night. Laboratory experience in techniques applicable to biotechnology: protein chemistry, molecular biology, and immunology.

556 Physiology I (3 cr.) P: K103, CHEM C342. Fall, night. Principles of physiology. Nerve and muscle, temperature regulation, ion and water balance.

557 Physiology II (3 cr.) P: 556 or consent of instructor. Spring, night. A study of human cardiovascular, pulmonary, blood, and gastrointestinal systems. Higher neuronal functions and intersystem interactions will be discussed.

561 Immunology (3 cr.) P: K103, CHEM C341. Fall, day. Introduction to the basic principles of immunology and serology at the molecular, cellular, and organismal level.

566 Developmental Biology (3 cr.) P: 501 and K322. Fall, odd years, night. Principles of development with emphasis on concepts and underlying mechanisms, including descriptive, physiological, and molecular approaches.

567 Laboratory in Developmental Biology (1 cr.) P or C: 566. Fall, odd years, night. Descriptive and experimental study of plants and animals.

570 Biological Membranes (3 cr.) P: Either 501, CHEM C342, or consent of instructor. Spring, odd years, night. An examination of structure and function of biological membranes. Topics include lipid and protein composition and interactions, physiological properties of membranes, physiological methods of analysis, model membrane systems, and survey of specific biological membranes and their mode of action.

571 Developmental Neurobiology (3 cr.) P: 501 or consent of instructor. Fall, odd years, night. The major phases of nervous system development beginning with neurolation and neurogenesis and ending with the onset of physiological activity will be studied in a variety of animals, mainly avians and mammals (including man). Neural developmental disorders and behavioral ontogeny will also be considered.

583 Biological Regulation (3 cr.) P: K483, 501, or equivalent. Fall, odd years, night. A study of how metabolism is regulated in response to cellular environment. The role played by endocrine systems, regulatory enzymes, second-messengers, feedback mechanisms, etc., will be explored with emphasis on the importance of regulation to development, homeostasis, and pathology of multicellular organisms.

595 Special Assignments (1-3 cr.) P: Consent of instructor. Fall, Spring, Summer. Special work, such as directed reading, independent study or research, supervised library, laboratory or field work, or presentation of material not available in the formal courses of the department.

Graduate Level

641 Microbial Genetics (2 cr.) P: K323, CHEM C342, and consent of instructor. Spring, odd years, day, night. Genetics of bacteria, bacterial viruses, and other microorganisms with emphasis on organization, replication, and function of the genetic material.

651 Cellular Immunology (3 cr.) P: BIOL 561. Spring, night. Study of cells, molecules, and mechanisms comprising the cellular immune system in normalcy and disease.

696 Seminar (1 cr.) (May be repeated for credit.) Fall, Spring. Each semester there are several separate offerings. They will likely be on the following topics: biochemistry, biology teaching, ecology and population biology, genetics, mechanisms of development, microbiology, neurobiology, and plant physiology. Oral presentations required.

697 Special Topics (1-3 cr.) (May be repeated for credit.) Fall, Spring. The frontiers of biology. Critical examination of developments in the various specialities represented by the members of the department. Currently, advanced work in the following and related fields can be offered: molecular genetics; structure and biosynthesis of biologically significant molecules; the nature of biological

specificity and enzyme catalysis; the fine structure and chemistry of subcellular particles, cells, and tissues; microbial and plant metabolism; comparative biochemistry; genetics and physiology of viruses, bacteria, fungi, protozoa, helminths, and cells of higher forms of life; the genetics, structure, development, and physiology of plants and animals, including endocrinology and work physiology; excitable membranes; neurobiology, ecology, systematics, and evolution of microorganisms, plants and animals; host-parasite relationships including immunology; and the teaching of biology. The field in which work is offered will be indicated in the student's record.

698 Research M.S. Thesis (cr. arr.)

699 Research Ph.D. Thesis (cr. arr.)

Courses for the Nonmajor

N100 Contemporary Biology (3 cr.) P: None. Fall, day, night; Spring, day, night; Summer. Selected principles of biology with emphasis on issues and problems extending into everyday affairs of the student.

N107 Introduction to Zoology (4 cr.) P: None. Equiv. PU BIOL 109. Fall, day, night; Spring, day, night; Summer, day. Basic principles of biology, growth, reproduction, energy transport, heredity as they occur in animals. Survey of the animal kingdom emphasizing structure as related to function as well as taxonomic relationships.

N200 The Biology of Women (3 cr.) P: None. Fall, day, night; Spring, day, night; Summer. This course examines the biological basis for bodily functions and changes that take place throughout the life of females.

N212 Human Biology (2 cr.) P: None. Equiv. PU BIOL 201. Fall, day. Two-semester sequence in human biology with emphasis on anatomy and physiology providing a solid foundation in body structure and function.

N213 Human Biology Laboratory (1 cr.) P or C: N212. Equiv. PU BIOL 203. Fall, day. Accompanying laboratory for N212.

N214 Human Biology (2 cr.) P: N212. Equiv. PU BIOL 202. Spring, day. Continuation of N212.

N215 Human Biology Laboratory (1 cr.) P or C: N214. Equiv. PU BIOL 204. Spring, day. Accompanying laboratory for N214.

N217 Human Physiology (5 cr.) P: None. Equiv. IU PHSL P215. Fall, day; Spring, day; Summer, day. Lectures and laboratory work related to cellular, musculoskeletal, neural, cardiovascular, gastrointestinal, renal, endocrine, and reproductive function in humans.

N222 Special Topics in Biology (1-3 cr.) P: None. A variable topics course dealing with current topics in biology. In a given semester, a topic such as disease, genetics, the environment, etc., will be dealt with as a separate course.

N251 Introduction to Microbiology (3 cr.) P: One semester general chemistry or one semester life science. Spring, night. The isolation, growth, structure, functioning, heredity, identification, classification, and ecology of microorganisms; their role in nature and significance to humans.

N261 Human Anatomy (5 cr.) P: None. Equiv. IU ANAT A215. Fall, day, night; Spring, day, night; Summer, day, night. Lecture and laboratory studies of the histology and gross morphology of the human form, utilizing a cell-tissue-organ system-body approach.

N322 Introductory Principles of Genetics (3 cr.) P: N107 or K101. Equiv. PU AGRY 430. Spring, night. Basic principles of plant and animal genetics. Emphasis on transmission mechanisms as applied to individuals and populations. For students in health and agricultural sciences.

N400 Biological Skills for Teachers (3 cr.) P: Consent of instructor. Fall, night. Concepts and laboratory skills necessary to prepare teachers with diverse backgrounds to return to graduate academic biology courses are reviewed. Topics include general principles of biology, biochemistry, and biomathematics.

Chemistry students conducting organic synthesis experiment.

Department of Chemistry

Professors Boschmann, Dubin, Dykstra, Fife, Larter, Lipkowitz, O'Donnell, Schultz, Sunderwirth (IUPUI Columbus), Zeldin

Professors Emeriti Boaz, Welcher

Associate Professors Cutshall, Fricke, Malik (*Chairperson*), Muhoberac, Nurok, Wyma

Assistant Professors Breen, Long, Sen

Adjunct Professors Boyd, Scriven

Departmental Academic Advisers Contact the department for assignment to an adviser.

Chemistry is the science that studies substances, both natural and synthetic, and their compositions, properties, transformations, and interactions with external forces.

The Department of Chemistry offers the Bachelor of Arts degree, the Bachelor of Science in Chemistry degree with a chemistry option and a biological chemistry option, and the Master of Science degree.[1] A minor in chemistry is also offered. The Bachelor of Science degree carries certification by the American Chemical Society Committee on Professional Training. The Master of Science degree has both a thesis and nonthesis option. An Industrial Co-op Program is also offered for the Master of Science degree. Qualified students may be authorized to pursue the Ph.D. degree in chemistry in the areas of analytical, biological, inorganic, organic, and physical chemistry. Contact the Department of Chemistry for further details.

To enter the curriculum in chemistry, a student should have completed a minimum of two years of algebra, one semester of trigonometry, one year each of chemistry and physics, and two years of a modern foreign language. The choice of a particular degree program in chemistry and the selection of courses for that degree must be made in consultation with a departmental adviser.

Students in programs that require only one semester of chemistry should take C101. Students with an insufficient background in high school chemistry to qualify for C105 should take C101 as a preparatory course. Students in programs that require two semesters of chemistry take either the C101-C102 sequence, the C105-C106 sequence, or the C111-C112 sequence (see specific program for degree major). The C101-C102 sequence is designed for students who do not need chemistry as a tool subject. The C105-C106 sequence is designed for students pursuing advanced work in scientific fields (e.g., biology, chemistry, geology, medicine, physics). The C111-C112 sequence is designed for students who are majoring in engineering or who desire a nonlaboratory version of C105-C106. If engineering students wish to take a laboratory, they may either enroll in the C105-C106 sequence or enroll in C125 along with C111 and in C126 along with C112. C105 is considered equivalent to the combined courses C111-C125 and C106 is considered equivalent to the combined courses C112-C126. Credit can only be earned in either the C105-C106 sequence or the C111-C125 and C112-C126 sequence. If both C101 and C105 or C111 are taken, the credit hours earned in C101 will not count toward the total credit hours needed for graduation. Admission to C106 or C112 on the basis of the student's having taken C101 is not allowed.

Bachelor of Arts

PREPROFESSIONAL CHEMISTRY MAJOR

For students who require a knowledge in chemistry as a basis for work in other fields. Suitable for students who plan chemical industry positions as laboratory technicians. Recommended for premedical students with minimum preparation.

Degree Requirements

Areas I, IIIA, and IIIB See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree" in this bulletin. The second semester of English composition may be satisfied only by ENG W132 (or ENG W150), ENG W231, ENG W233, ENG W290, or TCM 320.

Area II There is no foreign language requirement.

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[1]All degrees carry the general requirements of the School of Science. These are described elsewhere in this bulletin.

Area IIIC Physical and Biological Sciences PHYS P201 and PHYS P202 (recommended PHYS 152 and PHYS 251). Also, at least two additional courses outside chemistry having a laboratory component, which may be chosen from, for example, biology, geology, or physics.

Area IIID Mathematical Sciences MATH 221 and MATH 222 (recommended MATH 163 and MATH 164), and CSCI 220.

Area IV Chemistry Concentration Requirements C105, C106, C310, C311, C325, C341, C342, C343, C344, C360 (recommended C361). Recommended C483. Total of 32 credit hours of chemistry courses required.

Bachelor of Science in Chemistry

PROFESSIONAL CHEMISTRY MAJOR

A.C.S. Certified

This degree is for students who plan to be professional chemists or secondary school teachers or who plan to pursue graduate studies in chemistry. It carries certification by the Committee on Professional Training of the American Chemical Society. Two options are available: a chemistry option and a biological chemistry option.

Degree Requirements (Chemistry Option)

Areas I, IIIA, and IIIB See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree" in this bulletin. The second semester of English composition may be satisfied only by ENG W132 (or ENG W150), ENG W231, ENG W233, ENG W290, or TCM 320.

Area II There is no foreign language requirement.

Area IIIC Physical and Biological Sciences PHYS 152, PHYS 251, and at least two additional courses outside chemistry, which may be chosen from, for example, biology, geology, or physics.

Area IIID Mathematical Sciences MATH 163, MATH 164, MATH 261, MATH 262, and CSCI 220.

Area IV Chemistry Concentration Requirements C105, C106, C310, C311, C341, C342, C343, C344, C361, C362, C363, C410, C411, C430, and C435. Total of 42 credit hours of chemistry courses required.

In addition to the above requirements, a minimum of 3 additional credit hours of advanced technical elective courses is required. Courses may be chosen from the following: CHEM C409 (3 cr. min.), CHEM C483, any graduate-level chemistry course (permission required), MATH 351, any 300-level or higher biology, computer science, geology, or physics course.

Degree Requirements (Biological Chemistry Option)

Areas I, IIIA, and IIIB See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree" in this bulletin. The second semester of English composition may be satisfied only by ENG W132 (or ENG W150), ENG W231, ENG W233, ENG W290, or TCM 320.

Area II There is no foreign language requirement.

Area IIIC Physical and Biological Sciences PHYS 152, PHYS 251, BIOL K101, BIOL K103.

Area IIID Mathematical Sciences MATH 163, MATH 164, MATH 261, MATH 262, and CSCI 220.

Area IV Chemistry Concentration Requirements C105, C106, C310, C311, C341, C342, C343, C344, C361, C362, C363, C483, C484, C486, and either C410-C411 or C430-C435. Total of 45 credit hours of chemistry courses required.

Chemistry Plans of Study

Bachelor of Arts—Preprofessional Chemistry Major (124 cr.)

Freshman Year

First Semester
CHEM C105 Principles of Chemistry I.....5
ENG W131 Elementary Composition I.....3
MATH 221 Calculus for Technology I.....3
Arts and Humanities Elective.....3
14

Second Semester
CHEM C106 Principles of Chemistry II.....5
MATH 222 Calculus for Technology II.....3
PHYS P201 General Physics I.....5
Second Composition Course.....3
16

Sophomore Year

Third Semester
CHEM C341 Organic Chemistry I.....3
CHEM C343 Organic Chemistry Laboratory I.....2
COMM C110 Fundamentals of Speech Communication.....3
PHYS P202 General Physics II.....5
Social and Behavioral Sciences Elective.....3
16

Fourth Semester
CHEM C342 Organic Chemistry II.....3
CHEM C344 Organic Chemistry Laboratory II.....2
CSCI 220 Problem Solving with Computers...3
Arts and Humanities Elective.....3
Science Elective.....4-5
15-16

Junior Year

Fifth Semester
CHEM C310 Analytical Chemistry.....3
CHEM C311 Analytical Chemistry Laboratory.....1
Arts and Humanities Elective.....3
Science Elective.....4-5
Social and Behavioral Sciences Elective.....3
14-15

Sixth Semester
CHEM C325 Introductory Instrumental Analysis.....5
CHEM C360 Elementary Physical Chemistry.....3
Arts and Humanities Elective.....3
Social and Behavioral Sciences Elective.....3
Elective.....3
17

Senior Year

Seventh Semester
Social and Behavioral Sciences Elective.....3
Electives.....12-13
15-16

Eighth Semester
Electives.....15-16
15-16

Bachelor of Science in Chemistry, Chemistry Option—Professional Chemistry Major—A.C.S. Certified (124 cr.)

Freshman Year

First Semester
CHEM C105 Principles of Chemistry I.....5
COMM C110 Fundamentals of Speech Communication.....3
ENG W131 Elementary Composition I.....3
MATH 163 Integrated Calculus and Analytical Geometry I.....5
16

Second Semester
CHEM C106 Principles of Chemistry II.....5
MATH 164 Integrated Calculus and Analytical Geometry II.....5
PHYS 152 Mechanics.....4
Second Composition Course.....3
17

Sophomore Year

Third Semester		Fourth Semester	
CHEM C341 Organic Chemistry I	3	**CHEM C342** Organic Chemistry II	3
CHEM C343 Organic Chemistry Laboratory I	2	**CHEM C344** Organic Chemistry Laboratory II	2
MATH 261 Multivariate Calculus	4	**CSCI 220** Problem Solving with Computers	3
PHYS 251 Heat, Electricity, and Optics	5	**MATH 262** Linear Algebra and Differential Equations	4
	14	Arts and Humanities Elective	3
			15

Junior Year

Fifth Semester		Sixth Semester	
CHEM C310 Analytical Chemistry	3	**CHEM C361** Physical Chemistry of Bulk Matter	4
CHEM C311 Analytical Chemistry Laboratory	1	**CHEM C363** Experimental Physical Chemistry	2
CHEM C362 Physical Chemistry of Molecules	4	Arts and Humanities Elective	3
Science Elective	4-5	Science Elective	4-5
Social and Behavioral Sciences Elective	3	Social and Behavioral Sciences Elective	3
	15-16		16-17

Senior Year

Seventh Semester		Eighth Semester	
CHEM C410 Principles of Chemical Instrumentation	3	**CHEM C435** Inorganic Chemistry Laboratory	2
CHEM C411 Principles of Chemical Instrumentation Laboratory	2	Technical Elective	3
CHEM C430 Inorganic Chemistry	3	Electives	10
Electives	7		15
	15		

Bachelor of Science in Chemistry, Biological Chemistry Option—Professional Chemistry Major—A.C.S. Certified (124 cr.)

Freshman Year

First Semester		Second Semester	
CHEM C105 Principles of Chemistry I	5	**CHEM C106** Principles of Chemistry II	5
COMM C110 Fundamentals of Speech Communication	3	**MATH 164** Integrated Calculus and Analytical Geometry II	5
ENG W131 Elementary Composition I	3	**PHYS 152** Mechanics	4
MATH 163 Integrated Calculus and Analytical Geometry I	5	Second Composition Course	3
	16		17

Sophomore Year

Third Semester		Fourth Semester	
CHEM C341 Organic Chemistry I	3	**CHEM C342** Organic Chemistry II	3
CHEM C343 Organic Chemistry Laboratory I	2	**CHEM C344** Organic Chemistry Laboratory II	2
MATH 261 Multivariate Calculus	4	**CSCI 220** Problem Solving with Computers	3
PHYS 251 Heat, Electricity, and Optics	5	**MATH 262** Linear Algebra and Differential Equations	4
	14	Arts and Humanities Elective	3
			15

Junior Year

Fifth Semester

CHEM C310 Analytical Chemistry 3
CHEM C311 Analytical Chemistry Laboratory 1
CHEM C362 Physical Chemistry of Molecules 4
BIOL K101 Concepts of Biology I—Plants 5
Social and Behavioral Sciences Elective 3
16

Sixth Semester

CHEM C361 Physical Chemistry of Bulk Matter 4
CHEM C363 Experimental Physical Chemistry 2
BIOL K103 Concepts of Biology II—Animals 5
Arts and Humanities Elective 3
14

Senior Year

Seventh Semester

CHEM C410 Principles of Chemical Instrumentation *or*
CHEM C430 Inorganic Chemistry 3
CHEM C411 Principles of Chemical Instrumentation Laboratory[1] 2
CHEM C483 Biological Chemistry 3
Social and Behavioral Sciences Elective 3
Electives ..... 6 or 8
17

Eighth Semester

CHEM C435 Inorganic Chemistry Laboratory[1] 2
CHEM C484 Biomolecules and Catabolism 3
CHEM C486 Biological Chemistry Laboratory 2
Electives ..... 8 or 10
15

The Department of Chemistry will not grant credit for a course when considerable duplication of course content may occur with another course taken. In general, credit will be allowed for the higher-level course, but not for the lower-level course. The following listings are considered to be duplications (lower-level courses listed first):

CHEM	C360	and	CHEM	C361
MATH	221-222	and	MATH	163-164
PHYS	P201-P202 or 218-219	and	PHYS	152-251
PHYS	100 or 200	and	PHYS	P201, 218, or 152

For example, if a student has earned credit in MATH 163-164, the student will receive no credit for MATH 221-222, even if earned previously.

On occasion, a student who initially enrolled in the preprofessional B.A. in chemistry program decides to transfer to the B.S. in Chemistry program, having already taken one or more of the above-listed lower-level courses. The following policies will apply:

If a student has a minimum grade of B (B– or lower unacceptable) in CHEM C360 and approval of the departmental chairperson, credit will be granted for CHEM C361 and the student may proceed to CHEM C362.

If a student has earned credit for the MATH 221-222 sequence, the student will be placed in MATH 164. If the student passes MATH 164, the MATH 163-164 requirement will be considered fulfilled. Credit will be granted for MATH 221 and MATH 164 only (8 credit hours). If the student does not pass MATH 164, the student must start with MATH 163.

If a student has earned credit for MATH 221 only, the student must take the MATH 163-164 sequence, and no credit will be allowed for MATH 221.

If a student has earned credit for the PHYS P201-P202 or PHYS 218-219 sequence, the student will be placed in PHYS 251. If the student passes PHYS 251, the PHYS 152-251 requirement will be considered fulfilled. Credit will be granted for PHYS P201 and PHYS 251 only (10 credit hours). If the student does not pass PHYS 251, the student must start with PHYS 152.

If a student has earned credit for PHYS P201 or PHYS 218 only, the student must take the PHYS 152-251 sequence, and no credit will be allowed for PHYS P201 or PHYS 218.

On occasion, a student who initially enrolled in the B.S. in Chemistry program decides to transfer to the preprofessional B.A. in chemistry program, having already taken one or more of the above-listed higher-level courses. A higher-level course will always substitute for a lower-level course to satisfy the requirement.

[1]CHEM C411 is for those taking CHEM C410; CHEM C435 is for those who took CHEM C430.

The Department of Chemistry will accept a maximum of 15 credit hours toward graduation in courses outside the Schools of Science, Liberal Arts, Business, Engineering, and Public and Environmental Affairs (e.g., technology, physical education, military science, therapy, etc.).

Minor in Chemistry

The minor in chemistry requires 24 credit hours of chemistry courses. The following courses are required: CHEM C105, C106, C310, C341, C342, C343, and C360. MATH 222 and PHYS P202 are prerequisites for CHEM C360. For other requirements see "Undergraduate Programs, Minors" in this bulletin.

Master of Science Program

The M.S. program in chemistry, which awards a Purdue University degree, requires 30 credit hours of study beyond the baccalaureate level. It is designed for students seeking careers as professional chemists. Graduates of the program often choose industrial positions, but others enter Ph.D. programs in chemistry or related areas. Graduates have been placed in positions throughout the United States and abroad.

Admission Requirements

The prospective student should have a baccalaureate degree from an accredited institution, show promise of ability to engage in advanced work, and have adequate preparation—at least 35 credit hours of chemistry—in a chemistry curriculum. The GRE subject exam in chemistry is strongly recommended.

Incoming students with an undergraduate grade point average (GPA) of 3.0 or higher (A=4.0) will automatically be recommended for admission as regular graduate students. Those with a GPA below 3.0 will be admitted as temporary graduate students with the provision that a 3.0 average must be achieved in the first three graduate courses (or 9 credit hours) if they are to be admitted as regular graduate students.

Application for Admission

Application for admission is made directly to the Department of Chemistry by writing to Graduate Admissions; Department of Chemistry; Science, Engineering, and Technology III; 402 N. Blackford Street; IUPUI; Indianapolis, IN 46202-3272 [(317) 274-6881]. Applications for full-time study should be completed by March for the following fall semester to ensure complete consideration for fellowships and other financial support (see "Graduate Program Financial Aid" in this section). Applications for part-time graduate admission may be submitted at any time.

Temporary graduate students who wish to enroll in courses, though not necessarily in a degree program, should contact the IUPUI Graduate Office, Union Building 203, IUPUI, Indianapolis, IN 46202-5167 [(317) 274-4023]. Students should be aware that no more than 12 credit hours earned as a nondegree student may be counted toward a degree program.

Transfer Credit

The Department of Chemistry will accept by transfer a maximum of 6 hours of graduate credit, in excess of undergraduate degree requirements, from approved institutions.

General Degree Options and Requirements

The M.S. degree can be earned through any of three different options: the thesis option, the Industrial Co-op Program, and the nonthesis option.

Thesis Option This traditional full-time program requires 20 hours of course work and 10 hours of thesis research. The research activity culminates in the completion and defense of a thesis. This option is available to full- or part-time students.

Industrial Co-op Program This full-time program has the same requirements as the thesis option, but includes industrial work experience in the Indianapolis area. The program is described in detail in the following section, "Master of Science Industrial Co-op Program."

Nonthesis Option The nonthesis option requires 30 hours of course work alone. Since actual research experience is essential in an advanced chemistry program, this option is recommended for part-time students only. Students in this option are usually employed full time and are

already engaged in research activity as part of their employment. However, nonthesis students may still enroll in a limited amount of research study that applies to the degree requirements (usually through CHEM 599).

Specific area requirements (core courses) also apply for course work. Courses from three of the follwoing areas must be taken: analytical, biological, inorganic, organic, and physical. Typically, students take three courses in their primary area and two courses outside of it to meet these requirements.

Master of Science Industrial Co-op Program

Although most chemists seek a career in industry upon completion of their educational goals, few have had the industrial experience or opportunity to develop an appreciation for the types of problems presented in the industrial setting. The Industrial Co-op Program in Indianapolis is designed to provide industrial experience and to offer an alternative approach to career preparation. Most graduates leave with a strong, research-based M.S. degree plus meaningful work-study experience commensurate with graduate-level training. Students may also enter the Ph.D. program and participate in the co-op program for the first two years of their residency.

The M.S. Industrial Co-op Program requires 24 months of full-time study. The first semester consists of intensive course work, interviews with several local industrial laboratories, and familiarization with faculty research interests. In the second semester, parallel work experience begins, consisting of 20 hours per week on site and 20 hours per week in an academic lab. This work experience is commensurate with the student's background and interests and is an important part of the overall training program. The faculty thesis adviser and the industrial supervisor serve together to monitor each student's progress in the program.

Most students who enter the co-op program have sound academic backgrounds and desire both industrial experience and an opportunity to pursue graduate studies in chemistry.

Ph.D. Program

The Ph.D. program is a full-time thesis-based research program. This program provides a substantially larger research component than that of the M.S. degree and requires original and significant research contributions by the student. As a result, the Ph.D. student is qualified for employment where the ability to design, develop, and complete a research program is expected. The program is part of the Purdue University systemwide doctoral program in chemistry, and, as such, identical requirements apply to all campuses participating in the program.

Doctoral candidates, like M.S. students, are expected to demonstrate proficiency in four of five basic areas of chemistry through the qualifying (proficiency) exams or the completion of designated courses.

Divisional requirements also apply. For most areas, candidates must pass preliminary examinations starting in the second year and must complete them by the third year. A written component covers the student's area of specialization and the oral part usually covers the thesis research. In addition, an original research proposition must be submitted prior to the written component. Currently, cumulative examinations are administered in lieu of the preliminary examination in the organic division, and a minimum number of these must be passed.

Course requirements include a core of three courses plus 8 credit hours outside of the student's major area. A number of additional courses may be recommended that cover material appropriate to the written part of the preliminary examination.

Joint M.D.–Ph.D. Program

The Department of Chemistry participates in the joint M.D.–Ph.D. program with the Indiana University School of Medicine. In this program, students concurrently earn an Indiana University Doctor of Medicine degree and Purdue University Ph.D. degree in chemistry. Students take courses in both chemistry and medicine with several courses simultaneously satisfying both degree requirements.

Eligible students must be admitted separately to the School of Medicine and the Department of Chemistry. Once admission to each is approved, students, together with advisers from medicine

and chemistry, plan a tentative course outline for a concurrent program. Graduate and teaching assistantships or fellowships are arranged primarily through the Department of Chemistry.

Molecular / Cellular / Biophysics Ph.D. Program

In cooperation with departments in the Indiana University School of Medicine and the Purdue University School of Science, this interdisciplinary program leads to an Indiana University Ph.D. degree in biophysics. The program is designed to give talented graduate students the skills required of the next generation of biologically oriented scientists. The program combines a core of courses in molecular and cellular biophysics with flexible electives and a seminar program. The training is oriented primarily toward faculty-directed research with focus points at the boundaries of the traditional disciplines of physics, chemistry, and biology. Prospective students should contact the director of graduate programs in the chemistry department for further information.

Graduate Program Financial Aid

Most full-time graduate students receive teaching assistantships ($13,000/year), research assistantships ($13,000/year), departmental fellowships ($13,000-$15,000/year), or university fellowships ($12,000-$13,000/year), or are supported through the Industrial Co-op Program ($15,000/year). Full-time students receive fee remissions; students with assistantships and fellowships are also eligible for health insurance.

Courses in Chemistry (CHEM)

Note: P—prerequisite; C—corequisite; R—recommended; Fall—offered fall semester; Spring—offered spring semester; Summer—offered during one or both summer sessions; Day—offered as a daytime section; Night—offered as an evening section; Equiv.—course is equivalent to the indicated course taught at Indiana University Bloomington, or the indicated course taught at Purdue University, West Lafayette.

C100 World of Chemistry (3 cr.) P: None. Fall, day; Spring, day. How molecules are built, react, and affect our lives. Lectures, demonstrations, and discussion. For students desiring only one semester of chemistry. Does not count toward any degree requirements in the School of Science.

C101 Elementary Chemistry I (5 cr., 3 cr. without laboratory) P: At least one semester of high school algebra. Equiv. PU CHEM 111-112. Fall, day, night; Spring, day, night; Summer, day, night. Essential principles of chemistry; atomic and molecular structure; bonding; properties and reactions of elements and compounds; stoichiometry; solutions; acids and bases. For students who are not planning careers in the sciences and for those with no previous course work in chemistry. Lectures, recitation, laboratory. Note: Most degree programs that include C101 require laboratory. Before registering for 3 credit hours, students should be certain that this meets the requirements of their program.

C102 Elementary Chemistry II (5 cr., 3 cr. without laboratory) P: C101. Continuation of C101. Equiv. PU CHEM 257-257L. Fall, day, night; Spring, day, night; Summer, day. Introduction to organic and biochemistry; organic compounds and their reactions. Lectures, recitation, laboratory.

C105 Principles of Chemistry I (5 cr., lecture, recitation, laboratory) P: Two years of high school algebra, one year of high school chemistry. Equiv. PU CHEM 115. Fall, day, night; Spring, day; Summer, day. Inorganic chemistry emphasizing physical and chemical properties, atomic and molecular structure, states of matter.

C106 Principles of Chemistry II (5 cr., lecture, recitation, laboratory) P: C105. Equiv. PU CHEM 116. Fall, day; Spring, day, night; Summer, day. Continuation of C105. Topics in inorganic chemistry emphasizing solution chemistry, thermodynamics, equilibrium, and kinetics.

C111 Chemical Science I (4 cr., lecture, recitation) P: Two years of high school algebra, one year of high school chemistry. Equiv. PU CHEM 101, IUPUI C105 lecture. Fall, day, night; Spring, day; Summer, day. Inorganic chemistry emphasizing physical and chemical properties, atomic and molecular structure, states of matter. A lecture course for engineering and other students. No laboratory requirement.

C112 Chemical Science II (3 cr., lecture) P: C111. Equiv. PU CHEM 102, IUPUI C106 lecture. Fall, day; Spring, day, night; Summer, day. Continuation of C111. Topics in inorganic

chemistry emphasizing solution chemistry, thermodynamics, equilibrium, and kinetics. Included also are topics in organic chemistry.

C125 Experimental Chemistry I (1 cr., laboratory) P or C: C111 or equivalent. Fall, day, night; Spring, day; Summer, day. Scheduled with the C105 laboratory. Laboratory work illustrating topics covered in the lecture of C105 and C111.

C126 Experimental Chemistry II (2 cr., recitation, laboratory) P or C: C112 or equivalent. Fall, day; Spring, day, night; Summer, day. Scheduled with the C106 laboratory. Continuation of C125. Laboratory work illustrating topics covered in the lecture of C106 and C112.

C209 Special Problems (1-2 cr.) P: Two semesters of college chemistry and consent of instructor. Equiv. PU CHEM 290. Every semester, time arranged. Individually supervised special problems of chemical interest, e.g., environmental problems, development of experiments, development of audiovisual materials, etc. May be repeated for credit, but maximum of 2 credit hours may be applied toward a chemistry degree.

C301 Chemistry Seminar I (1 cr.) P or C: C409 and consent of instructor. Fall, day. Topics in various areas of chemistry. Students are required to attend departmental seminars and to prepare and present at least one seminar on their research. C301 and C302 may be elected three semesters for credit.

C302 Chemistry Seminar II (1 cr.) P or C: C409 and consent of instructor. Spring, day. Content same as C301.

C309 Cooperative Education in Chemistry (1 cr.) P: General and organic chemistry and consent of departmental chairperson. Every semester, time arranged. Industrial or similar experiences in chemically oriented employment. Grade is determined on basis of employment visitations, a written student report, and a supervisor evaluation report. May be repeated for a maximum of 5 credit hours of which 3 may be used as satisfying an advanced chemistry elective.

C310 Analytical Chemistry (3 cr.) P: C106. With C311, Equiv. PU CHEM 321. Fall. Fundamental analytical processes including solution equilibria, theory and applications of electrochemistry and spectrophotometry, and chemical methods of separation.

C311 Analytical Chemistry Laboratory (1 cr.) P or C: C310. Fall. Laboratory instruction in the fundamental analytical techniques discussed in C310.

C325 Introductory Instrumental Analysis (5 cr.) P: C106. Spring. Instrumental methods of chemical analysis and separation for the chemical technician or preprofessional chemistry major.

C341 Organic Chemistry I (3 cr.) P: C106. Equiv. PU CHEM 261. Fall, day, night; Spring, day; Summer, day. Comprehensive study of aliphatic and aromatic compounds. Nomenclature, qualitative theory of valence, and reactions. Commercial and laboratory syntheses and uses of monofunctional compounds.

C342 Organic Chemistry II (3 cr.) P: C341. Equiv. PU CHEM 262. Fall, day; Spring, day, night; Summer, day. Syntheses and reactions of polyfunctional compounds. Natural and industrial products. Physical and chemical methods of purification.

C343 Organic Chemistry Laboratory I (2 cr.) P or C: C341. Equiv. PU CHEM 265. Fall, day, night; Spring, day, night. Summer, day. Fundamental laboratory techniques of organic chemistry and general synthetic methods.

C344 Organic Chemistry Laboratory II (2 cr.) P or C: C342. P: C343. Equiv. PU CHEM 266. Fall, day; Spring, day, night; Summer, day. Preparation, isolation, and identification of organic compounds; emphasis on modern research methods.

C360 Elementary Physical Chemistry (3 cr.) P: C106, MATH 222, PHYS P202. Spring, odd years, day; Spring, even years, night. Properties of gases and liquids, intermolecular forces, chemical thermodynamics, solutions, equilibria, kinetics, and introduction to quantum chemistry and spectroscopy. Topics in biophysical chemistry. For students who desire a survey course in physical chemistry.

C361 Physical Chemistry of Bulk Matter (4 cr.) P: C106, MATH 164, and PHYS P202 or PHYS 251. Equiv. PU CHEM 373 and 374. Spring, even years, day; Spring, odd years, night. Kinetic-molecular theory, gases, liquids, chemical thermodynamics, solutions, transport properties, and phase and chemical equilibria.

C362 Physical Chemistry of Molecules (4 cr.) P: C106, MATH 164, and PHYS P202 or PHYS 251. Equiv. PU CHEM 375. Fall, odd years, day; Fall, even years, night. Quantum chemistry, symmetry, atomic and molecular structure and spectra, solids, chemical kinetics, photochemistry, and introduction to statistical thermodynamics.

C363 Experimental Physical Chemistry (2 cr.) P: C362. P or C: C361. Equiv. PU CHEM 376. Spring, day, night. Experimental work to illustrate principles of physical chemistry and to introduce research techniques.

C409 Chemical Research (1-4 cr.) P: Junior or senior standing and consent of instructor. Equiv. PU CHEM 499. Every semester, time arranged. Chemical or literature research with

a report. Can be elected only after consultation with research adviser and approval of program. May be taken for a total of 10 credit hours, which count toward graduation. Three credit hours may be used to satisfy the advanced technical elective in the Bachelor of Science in Chemistry degree program.

C410 Principles of Chemical Instrumentation (3 cr.) P: C310, C311, C361. P or C: C362. Equiv. PU CHEM 424. Fall. Modern analytical methods, including electroanalytical techniques, quantitative spectrophotometry, chromatography, and radiochemical methods.

C411 Principles of Chemical Instrumentation Laboratory (2 cr.) P: C311. P or C: C410. Fall. Laboratory instruction in the instrumental analysis techniques discussed in C410.

C430 Inorganic Chemistry (3 cr.) P: C342. Equiv. PU CHEM 342. Fall. Reactions and properties of inorganic compounds in terms of their electronic and molecular structures. A survey of the synthesis and reactivities of important compounds of the representative elements with emphasis on group trends. The elementary chemistry of transition metals including magnetic and spectral properties of coordination compounds.

C435 Inorganic Chemistry Laboratory (2 cr.) P or C: C430. Spring. Synthesis, characterization, and study of chemical and physical properties of inorganic and organometallic compounds.

C483 Biological Chemistry (3 cr.) P: C342, and one semester of physical chemistry or consent of instructor. Fall. The chemical and biophysical properties of biologically important molecules and systems. Special emphasis on the relationship between structure and function in proteins, nucleic acids, and biomembranes, as well as bioenergetics, kinetics, allosteric interactions, and enzyme catalysis.

C484 Biomolecules and Catabolism (3 cr.) P: C483. Spring. Mechanisms of biological catalysis, metabolism, biosynthesis, regulation of genetic information, and molecular biology.

C486 Biological Chemistry Laboratory (2 cr.) P: C483 or equivalent. Spring. An introduction to the important laboratory techniques currently employed by practicing biological chemists, including biomolecule isolation, purification, enzyme kinetics, and biomolecule characterization by electrophoresis, centrifugation, and spectroscopic methods.

525 Intermediate Analytical Chemistry (3 cr.) P: C310 and C311 or equivalent, C361 and C362 or equivalent. Fall. A critical review of physical and chemical methods of analysis.

533 Introductory Biochemistry (3 cr.) P: C342 or equivalent. Fall. A rigorous one-semester introduction to biochemistry.

542 Inorganic Chemistry (3 cr.) P: C430 or consent of instructor. Fall. Introduction to symmetry and group theory. Atomic structure; periodic table and property trends of the elements. Valence bond, molecular orbital, and ligand field theories as they apply to bonding, structure, and properties of inorganic and organometallic compounds. Acid-base and oxidation-reduction reactions; mechanisms in inorganic chemistry.

561 Fundamental Organic Chemistry (3 cr.) P: C342 or equivalent. Fall, night. A general survey of synthetic organic chemistry including some discussion of current organic theory. Graduate students with a declared major in organic chemistry may not apply 561 for credit.

575 Intermediate Physical Chemistry (3 cr.) P: C362 or equivalent. Fall. Quantum theory of atoms and molecules; theories of chemical bonding; molecular spectroscopy; methods for determining molecular structure; electrical and magnetic properties.

599 Special Assignments (1-4 cr.) P: Consent of instructor. Every semester, on demand, time arranged. Directed reading or special work not included in other courses.

621 Advanced Analytical Chemistry (3 cr.) P: C310, C410. Equiv. IU CHEM C510. Fall. A critical survey of recent developments in chemical and instrumental methods of analysis.

629 Chromatographic Methods of Analysis (3 cr.) P: C410 or equivalent. Spring. Principles and practice of modern gas and liquid chromatography are developed from an integrated point of view. Emphasis is placed on those features useful in practical analytical separations. Instrumentation is described and evaluated using chemical examples from recent literature. Although column techniques are emphasized, thin-layer chromatography and electrophoresis methods are also described.

634 Biochemistry: Structural Aspects (3 cr.) P: C310, C342, C361, and C362 or equivalent. Chemistry of materials of biochemical interest; carbohydrates, lipids, proteins, amino acids, nucleic acids, porphyrins, biochemistry of blood.

636 Biochemical Mechanisms (3 cr.) P: One year of physical chemistry and 651. Spring, day. The chemical basis of enzymatic catalysis with particular emphasis on catalytic interactions important in aqueous media.

641 Advanced Inorganic Chemistry (3 cr.) P: C430 or 542. Applications of symmetry and group theory to structure, bonding, and spectral properties in inorganic chemistry. Advanced topics in representative and transition element chemistry such as determination of structure from physical and spectroscopic properties, inorganic and organometallic polymers, characteristics of inorganic cluster compounds, catalysis, and structure and properties of inorganic solids.

651 Advanced Organic Chemistry (3 cr.) P: C342 or equivalent. Equiv. IU CHEM C540. Fall, night. Modern structural organic chemistry, including introductions to molecular orbital theory and reaction mechanisms.

652 Synthetic Organic Chemistry (3 cr.) P: 651. Equiv. IU CHEM C543. Spring, odd years, night. An advanced treatment of methods for preparing major types of organic functionalities and bonds, stressing stereochemical control and involving mechanisms for understanding the reactions employed.

657 Reaction Mechanisms (3 cr.) P: 651. Fall, even years, night. Mechanisms of representative reactions and methods used in their investigation.

669 Theoretical Organic Chemistry (3 cr.) P: 651. Theoretical aspects of organic chemistry at the molecular level and its relationship to bonding and reactions.

672 Quantum Chemistry (3 cr.) P: One year of physical chemistry. Equiv. IU CHEM C661. Basic principles of classical and quantum mechanics; exact solutions for simple systems; approximation methods; atomic structure; spectroscopy; application of group theory; theory of molecular binding.

675 Chemical Kinetics (2 or 3 cr.) P: One year of physical chemistry. Equiv. IU CHEM C673. Spring, even years. Experimental and theoretical considerations of chemical reaction rates and mechanisms.

682 Statistical Thermodynamics (3 cr.) P: C362 or equivalent. Application of statistical mechanics to the description of imperfect gases, liquids, and solutions, to order-disorder phenomena in solids and surfaces, and to absolute reaction rate theory.

695 Seminar (0 or 1 cr.) For graduate students (may be repeated for credit). Groups meeting for review and discussion of important current literature in analytical, biological, inorganic, organic, and physical chemistry. All graduate students are required to attend the seminar of their major subject.

696 Special Topics in Chemistry (1-3 cr.) On demand, night. Lectures on selected topics of current interest, as follows:

Analysis and Characterization of Synthetic Polymers A description of the principles and techniques of solution characterization and molecular weight methods, polymer spectroscopy, thermal analysis, and evaluation of mechanical properties.

Bioorganic Chemistry A presentation of principles and strategies used in modern bioorganic chemistry: structures and reactivities of biological macromolecules such as proteins, enzymes, and nucleic acids and their relevance to bioorganic chemistry. Current experimental studies of enzymes, nucleic acids, catalytic antibodies, and DNA strand scission/modification.

Biophysical Chemistry Structure and properties of biologically important macromolecules in solution with special emphasis on protein conformation and denaturation, thermodynamics of ligand binding, diffusion and transport, membrane phase transitions, and spectroscopic analysis.

Chemometrics The theory and application of mathematical and statistical methods as used to obtain optimum information from experimental chemistry measurements.

Electroanalytical Chemistry Principles of modern methods of electroanalytical chemistry and quantitative applications to electrode reaction mechanisms and analytical determinations.

Heterocyclic Chemistry The chemistry of five- and six-membered ring heterocyclic systems with emphasis on structure, physical properties, and preparative and ring substitution reactions. New synthetic methods, industrial applications, and use of heterocycles in the synthesis of complex molecules.

Medicinal Chemistry The application of the basic concepts of organic chemistry, biochemistry, and pharmacology to the design of organic medicinal agents as well as recent advances in synthesis and evaluation of pharmaceuticals.

Organometallics in Organic Synthesis The use of organometallic reagents in organic synthetic methodology.

698 Research M.S. Thesis (cr. arr.)

699 Research Ph.D. Thesis (cr. arr.)

Department of Computer and Information Science

Professors Chin (*Chairperson*), John Gersting, Judith Gersting, Yovits
Associate Professors Olson, Patterson
Assistant Professors Cox, Dey, Hudli, Li, Palakal, Wu

The Department of Computer and Information Science offers both the Bachelor of Science and the Master of Science degrees. The programs of study emphasize the basic principles of computing and information processing, which include the creation, representation, storage, transformation, and transmission of information. Since computers are used in all segments of society, the theory and practice of computer and information science are pervasive and the field is, therefore, interdisciplinary. It is also young and dynamic, as evidenced by the growth of the computer industry. In response to rapid developments in computer and computing science, the curriculum evolves accordingly to remain current.

Students completing the undergraduate degree in computer and information science will have acquired a fundamental understanding of computing, information processing, and information communication. The department's graduates function successfully in a variety of programming, systems analysis, management, and research positions in such fields as business, science, engineering, education, health science, and manufacturing.

Bachelor of Science

Degree Requirements

See the section "Undergraduate Programs, Bachelor of Science Degree" in this bulletin for the general and area degree requirements. Computer science majors are admitted only provisionally to the program until they have completed MATH 163 and CSCI 230 and 240 with an average grade of B– or higher. Please note that computer and information science courses below CSCI 230, mathematics courses below MATH 163, and statistics courses below STAT 311 are not credited toward the degree. Furthermore, the School of Science will not accept certain university courses for the computer science degree program (see Item 10 under "Undergraduate Programs, Baccalaureate Degree, General Requirements" in this bulletin). Degree programs in computer science require a minimum of 124 credit hours.

Area I See School of Science requirements under "Undergraduate Program, Bachelor of Science Degree" listed in this bulletin. The second semester of English composition *must* be satisfied with TCM 320 Written Communication in Science and Industry.

Area II There is no foreign language requirement.

Areas IIIA and IIIB Mathematically oriented or computer-oriented courses in other schools may not be used to fulfill Area IIIA or IIIB requirements. Consult the department for advice before registering for such courses.

Area IIIC Physical and Biological Sciences The Department of Computer and Information Science requires *five* courses chosen from the areas of biology, chemistry, geology, and physics, or from certain courses in engineering. One class must have a designated laboratory component. Students pursuing the minor in business will substitute one business course for one nonlaboratory science course. Courses that *may not* be used to fulfill Area IIIC requirements include the following: BIOL N100, N120, N200, K309; CHEM C100, C101, C102; PHYS 100, 200, 218, 219, P201, P202; AST A100, A105; GEOL G107, G115, G130; and all agriculture courses. Consult a departmental adviser concerning the acceptability of other courses. The following engineering courses *may* be applied toward Area IIIC requirements: EE 201 and EE 207; EE 202; EE 266 and EE 267.

Area IV Major Requirements Minimum requirements are 67-71 credit hours of designated computer science and mathematics courses. Students who do not maintain a minimum GPA of 2.5 in MATH 163, 164, and 261 and in CSCI 230, 240, 300, and 340 will not be permitted to continue as departmental majors.

Computer and Information Science Program Tracks

Two tracks are available in the computer and information science degree program: the Computing Science Track and the Scientific Computing Track. Both tracks require the following courses:

1. The calculus sequence MATH 163, 164, 261; and MATH 351.
2. CSCI 230, 240, 265, 300, 340, 355, 362, 402, 403, and 450.

Additional track requirements are as follows:

Computing Science Track	**Scientific Computing Track**	
STAT 311 or 511	MATH 262	CSCI 475
CSCI 470	MATH 426	CSCI 476
CSCI/MATH 414	CSCI 437	CSCI 477
CSCI electives (12 credit hours)	CSCI elective (3 credit hours)	

For those courses counted toward the degree but taken outside the Schools of Science and Liberal Arts, the department strongly urges that they be chosen so as to form a cohesive support area for the applications of computer and information sciences (e.g., certain courses in the School of Engineering and Technology or the School of Business).

Minor in Computer and Information Science

The minor in computer and information science requires at least 18 credit hours, distributed as follows: CSCI 230, 240, 265, 300, 340, and 362.

A minimum grade point average of 2.5 must be maintained in these courses. At least 9 credit hours of the minor must be taken at IUPUI.

Students who wish to pursue a minor in computer and information science are required to consult with the department adviser [(317) 274-9727] regarding prerequisites. See also "Undergraduate Programs, Minors" in this bulletin for additional requirements.

Minor in Business

The School of Business grants a minor in business to computer and information science students. This requires 16 credit hours of business courses and 24 credit hours of related courses. The business courses are distributed as free elective credit toward the total of 124 credit hours needed for a bachelor's degree. The requirements for a business minor include the following business and related courses.

Business courses:

1. BUS A100, A201, and A202 are to be taken as prerequisite courses; a GPA of 2.3 (C+) in these courses is required.
2. BUS F301, M301, and P301 are to be taken concurrently after completing the prerequisite courses.

Related courses:

1. MATH 163.
2. STAT 311 or STAT 511.
3. ECON E201 and ECON E202.
4. CSCI 230, CSCI 443, and CSCI 541.

Computing Science Sample Program (124 cr.)

Freshman Year

First Semester		**Second Semester**	
CSCI 230 Computing I	4	**CSCI 240** Computing II	4
MATH 163 Calculus I	5	**CSCI 265** Advanced Programming	3
ENG W131 Elementary Composition I	3	**MATH 164** Calculus II	5
Humanities or Social Science Elective	3	Humanities or Social Science Elective	3
	15		15

Sophomore Year

Third Semester		Fourth Semester	
CSCI 300 Systems Programming	3	**CSCI 355** Introduction to Programming Languages	3
CSCI 340 Discrete Computational Structures	3	**CSCI 362** Data Structures	3
MATH 261 Calculus III	4	**MATH 351** Elementary Linear Algebra	3
COMM C110 Fundamentals of Speech Communication	3	**TCM 320** Written Communication	3
Laboratory Science	4-5	Free Elective	3
	17-18		15

Junior Year

Fifth Semester		Sixth Semester	
CSCI 402 Architecture of Computers	3	**CSCI 403** Introduction to Operating Systems	3
CSCI 470 Automata and Formal Languages	3	**CSCI/MATH 414** Numerical Methods	3
STAT 311 Introductory Probability *or* **STAT 511** Statistical Methods	3	**CSCI** Advanced Elective	3
Science Elective	3-5	Science Elective	3-5
Free Elective	3	Free Elective	3
	15-17		15-17

Senior Year

Seventh Semester		Eighth Semester	
CSCI 450 Principles of Software Engineering	3	**CSCI** Advanced Elective	6
CSCI Advanced Elective	3	Humanities or Social Science Elective	3
Humanities or Social Science Elective	3	Science Elective	3-5
Science Elective	3-5	Free Elective	3
Free Elective	3		15-17
	15-17		

Scientific Computing Sample Program (124 cr.)

Freshman Year

First Semester		Second Semester	
CSCI 230 Computing I	4	**CSCI 240** Computing II	4
MATH 163 Calculus I	5	**CSCI 265** Advanced Programming	3
ENG W131 Elementary Composition I	3	**MATH 164** Calculus II	5
Humanities or Social Science Elective	3	Humanities or Social Science Elective	3
	15		15

Sophomore Year

Third Semester		Fourth Semester	
CSCI 300 Systems Programming	3	**CSCI 355** Introduction to Programming Languages	3
CSCI 340 Discrete Computational Structures	3	**CSCI 362** Data Structures	3
MATH 261 Calculus III	4	**MATH 351** Elementary Linear Algebra	3
COMM C110 Fundamentals of Speech Communication	3	**TCM 320** Written Communication	3
Laboratory Science	4-5	Free Elective	3
	17-18		15

Junior Year

Fifth Semester		Sixth Semester	
CSCI 402 Architecture of Computers	3	**CSCI 403** Introduction to Operating Systems	3
CSCI 475 Scientific Computing I	3	**CSCI 476** Scientific Computing II	3
MATH 262 Linear Algebra and Differential Equations	4	**MATH 426** Introduction to Applied Mathematics and Modeling	3
Science Elective	3-5	Science Elective	3-5
Free Elective	3	Free Elective	3
	16-18		15-17

Senior Year

Seventh Semester		Eighth Semester	
CSCI 450 Principles of Software Engineering	3	**CSCI 437** Introduction to Computer Graphics	3
CSCI 477 High Performance Computing	3	**CSCI** Advanced Elective	3
Humanities or Social Science Elective	3	Humanities or Social Science Elective	3
Science Elective	3-5	Science Elective	3-5
Free Elective	3	Free Elective	3
	15-17		15-17

Master of Science

This program, leading to a Purdue University degree, is offered at IUPUI primarily to serve students from the Indianapolis area who are interested in computer and information science. Many courses are offered in the late afternoon or evening to accommodate working students.

Prerequisites for Admission

A bachelor's or equivalent degree and an overall grade point average of 3.0 (B) or better are required by the Graduate School. Students must have completed the following courses or equivalents with grades of B or better before applying to the graduate program: MATH 163, 164, 261, 351 and CSCI 230, 240, 300, 340, 362, 402, 403, 470. These courses carry no credit toward the graduate degree. Students are strongly advised to have taken mathematics courses in differential equations.

The General Aptitude Test of the Graduate Record Exam (GRE) is required for admission. Regular graduate student application forms should be obtained from the Department of Computer and Information Science; Science, Engineering, and Technology II, Room 2260; 723 W. Michigan Street; IUPUI; Indianapolis, IN 46202-5132.

While the graduate application is being processed, the student may take courses as a temporary graduate student. Students with temporary graduate student status may also take any courses required for admission in which they may be deficient. No more than 12 hours of credit earned as a temporary graduate student may be applied toward a graduate degree. (Deficiency courses are not applied against the 12 credit hours since these courses carry no credit toward the degree.) Temporary graduate student application forms may be obtained from the IUPUI Graduate Office, Union Building 203, 620 N. Union Drive, IUPUI, Indianapolis, IN 46202-5167 [(317) 274-1577]. Temporary graduate students are encouraged to talk to the department adviser while seeking admission to the graduate program.

Program Requirements

The program consists of at least 30 credit hours of courses. The following courses are required of students who have not already had equivalent courses: CSCI 502 and CSCI 503; at least one of CSCI 514, 515, 516, 520; and at least one of CSCI 582 or MATH 585. The remaining courses are chosen by the student with the approval of the Graduate Committee. Generally these will consist of computer and information science courses numbered above 500, but a maximum of 6 credit hours of courses numbered above 500 in a related discipline may be allowed if approved in advance on the plan of study.

The student's formal plan of study must be submitted to and accepted by the Graduate School *before* the semester in which the student expects to receive the degree; students should submit a

plan of study as soon as possible after admission to the graduate program. The English requirement (see item 2 under "Graduate Programs, Purdue University Graduate Degrees" in this bulletin) must be satisfied before the plan of study can be approved. An applicant whose native language is not English must take the Test of English as a Foreign Language (TOEFL) before applying for admission.

Standard of Performance

In the courses on a plan of study, grades of A and B are expected; up to 6 credit hours with a grade of C may be included provided an overall grade point average of 3.0 (B) is maintained. Other grades are unacceptable.

Transfer of Credit

Credit for graduate courses taken at other institutions may be transferred with approval of the Graduate Committee and the Graduate School if the courses have not been used for other degree requirements. Transfer credits are normally limited to 6 credit hours. Application for the transfer of credit is made when the plan of study is presented for approval.

Courses in Computer and Information Science (CSCI)

Note: P—prerequisite; C—corequisite; R—recommended.

Undergraduate Level

201 Computer Literacy: Applications and Concepts (3 cr.) P: None. Not normally accepted for credit in computer science programs. An introduction to the use of computers intended for students in nontechnical disciplines. A survey of the computer and its role in society. The use of computer software, including a programming language, in various applications of interest to the generalist.

205 Computer Science for Allied Health (2 cr.) P: None. Not normally accepted for credit in computer science programs. An introduction to computers and computer programming. Programming in BASIC with emphasis on microcomputers. Graphics image processing, especially as it relates to medical imaging in the allied health sciences.

206 Computer Programming (3 cr.) P: None. Not normally accepted for credit in computer science programs. An introduction to computers and computer programming. Emphasis on problem solving and algorithm development using the BASIC and Pascal programming languages on microcomputers and mainframe computers. Primarily for education majors.

207 Computers in the Social Sciences (3 cr.) P: None. Not normally accepted for credit in computer science programs. An introduction to computers and computer programming. Elements of computer hardware and software, emphasis on problem solving, algorithm development, and programming in BASIC. Use of standard statistical packages. Social impact and ethical issues of computing.

208 The Computer in Business (3 cr.) P: MATH 118 or MATH 119. Not normally accepted for credit in computer science programs. Introduction to computers and their use in organizations. Elements of computer system, spreadsheet, and database organization. Strategies for using computers to solve problems in data management, forecasting, and communication. Computers in information systems. The impact of computers on society.

220 Problem Solving with Computers (3 cr.) P or C: MATH 151. Not accepted for credit in the computer science department's major or minor programs. An introduction to computer science with emphasis on using computers to solve problems with a high-level programming language. Emphasis on algorithm development and structured programming. Computer system organization, number representation, round-off errors, logic control structures, input/output, files, data structures, subprograms, modularization, error avoidance.

230 Computing I (4 cr.) P or C: MATH 163. History of computing: impact of computing in daily life. Overview of computer organization: information representation in digital computers, digital logic. Algorithmic approach to problem solving, elements of data structures: arrays, lists, stacks, and queues. Program development techniques, problem-solving techniques in numerical analysis problems and in nonalgorithmic problems, such as in artificial intelligence.

240 Computing II (4 cr.) P: 230. Large software development techniques, systems, and engineering approach. Fundamentals of operating systems: process, memory, and file management. File organization techniques: sequential, random, linked, and inverted file organizations. Database concepts: relational

data models, query languages, database systems. Programming language design, applications of artificial intelligence, and social and ethical issues in computing.

265 Advanced Programming (3 cr.) P or C: 240. The primary objective of the course is to teach students advanced programming skills. Advanced programming concepts; introduction to the principles of software engineering; problem specification; program design with emphasis on structured programming, programming style, debugging, and documentation. A large-scale software development project is required.

300 Systems Programming (3 cr.) P or C: 240 and 265. Assembly language programming and structure of a simple and a typical computer. Pseudo operations, address structure, subroutines, and macros. File I/O and buffering techniques. Interfacing with high-level languages. Assemblers: one and two pass assemblers, system dependent and independent assembler features, design options. Loaders, linkers, and macro processors.

340 Discrete Computational Structures (3 cr.) P: 240 and MATH 164. Theory and application of discrete mathematics structures and their relationship to computer science. Topics include sets, relations, functions, permutations, combinatorics, graphs, trees, Boolean algebra, recurrence relations, group theory, and finite-state automata.

355 Introduction to Programming Languages (3 cr.) P: 265 and 340. Programming language concepts and different paradigms of programming. Topics include syntax and semantics of high-level languages, parsing methods, subprograms and their implementation, data abstraction, language translation overview including lexical analysis, syntax directed translation, symbol table handling, code generation, functional programming, logic programming, and object-oriented programming.

362 Data Structures (3 cr.) P: 265 and 340. A study of the design and analysis of data structures and algorithms. Abstract data types: arrays, stacks, queues, lists, trees, graphs. Algorithms: sorting, searching, hashing. File structures: organization and access methods.

402 Architecture of Computers (3 cr.) P: 340. Basic logic design. Storage systems. Processor organization: instruction formats, addressing modes, subroutines, hardware and microprogramming implementation. Computer arithmetic, fixed and floating point operations. Properties of I/O devices and their controllers. Interrupt structure. Virtual memory structure, cache memory. Examination of architectures such as microcomputers, minicomputers, vector and array processors.

403 Introduction to Operating Systems (3 cr.) P: 300 and 362. Operating system concepts; history, evolution and philosophy of operating systems. Concurrent processes, processes coordination and synchronization, CPU scheduling, deadlocks, memory management, virtual memory, secondary storage and file management, device management, security and protection, networking, distributed and real-time systems.

414 Numerical Methods (MATH 414) (3 cr.) P: MATH 262 or MATH 351. Error analysis, solution of nonlinear equations, direct and iterative methods for solving linear systems, approximation of functions, numerical differentiation and integration, numerical solution of ordinary differential equations. Not open to students with credit in 512.

437 Introduction to Computer Graphics (3 cr.) P: 362, and MATH 262 or MATH 351. An introduction to graphics hardware; implementation and interaction with operating systems. Mathematical aspects of computer graphics: 2D and 3D transformations, homogeneous coordinates, clipping, 3D views and hidden line removal, 3D realistic viewing. High-level issues in user-interface design, application of computer graphics in science and industry, and application software packages.

443 Database Systems (3 cr.) P: 362. Relational database systems: architecture, theory, and application. Relational data structure, integrity rules, mathematical description, data manipulation. Standard SQL and its data manipulation language, engineering aspects of database design in industry, introduction to nonrelational database systems.

446 Introduction to Microprocessor Architecture (3 cr.) P: 402. Introduction to programmable logic; elements of microprocessor system design; interrupt structures; interfacing using LSI devices; hardware timers; interactive debugging; physical device I/O programming; vectored and polled service; microprocessor architecture; self-paced laboratory using A/D converters, D/A converters, etc.

450 Principles of Software Engineering (3 cr.) P: 355 and 362. Tools and techniques used in software development. Lifecycle concepts applied to program specification, development, and maintenance. Topics include overall design principles in software development; the use of structured programming techniques in writing large programs; formal methods of program

verification; techniques and software tools for program testing, maintenance, and documentation.

452 Object-Oriented Analysis and Design (3 cr.). P: 355 and 362. Introduction to the object-oriented paradigm in software development. Basic concepts: objects, classes, messaging, inheritance, methodologies. Analysis: defining objects, structures, attributes, services. Design: transforming the analytic model into the design model. Implementation: comparison of the support features provided by languages such as Smalltalk, C++, Eiffel, and CLOS. A significant design project.

463 Analysis of Algorithms (3 cr.) P: 362. Techniques for analyzing and comparing algorithms. Average case analysis in sorting and searching; dynamic programming: greedy algorithms, amortized analysis, and applications; matrix algorithms: polynomials, discrete Fourier transforms, and fast Fourier transforms; parallel algorithms: examples in sorting, searching, graphs, and matrices; computational complexity, polynomial complexity classes P, NP.

470 Automata and Formal Languages (3 cr.) P: 362. Introduction to formal languages and automata theory: finite automata and regular expressions, context-free grammars and languages, pushdown automata, equivalence of CFGs and pushdown automata, application of pushdown automata in parsing, closure properties, pumping lemmas, decision procedures, Turing machines, computability, undecidability, and a brief survey of the Chomsky hierarchy.

475 Scientific Computing I (3 cr.) P: 230 and MATH 351. P or C: MATH 262. Solving scientific problems on computers. Languages for scientific computing. Software development on workstations: using tools the environment provides, organization of programs. Computer architecture: impact on software and algorithms. Problem formulation: model selection/simplification, relationship to numerical methods. Solution of linear equations: methods and packages. Nonlinear equations and optimization problems.

476 Scientific Computing II (3 cr.) P: 475. Elementary statistical computing: time series analysis, model fitting, robust methods, generation of pseudorandom numbers, and Monte Carlo methods. Interpolation and curve fitting; numerical integration. Solving ordinary differential equations. Use of packaged environments and symbolic computation for scientific purposes.

477 High Performance Computing (3 cr.) P: 476. Architecture of supercomputers: pipelined, vector, SIMD, MIMD; implications for algorithm and program design; vectorization, parallelization, loop restructuring, nonstandard language features. Splitting computation between supercomputers and workstations; interactive analyses of remote machines' output. Numerical methods for large-scale problems: examples from continuum mechanics, graphical visualization, statistical computing. A project is required.

485 Expert System Design (3 cr.) P: 362. Overview of AI; expert system technology; early expert systems: MYCIN, DENDRAL; theoretical foundations, uncertainty measures, knowledge representation, inference engines; reasoning mechanisms: forward and backward chaining; explanation systems, expert system shells, tools, and intelligent hybrid systems.

487 Artificial Intelligence (3 cr.) P: 362. Study of key concepts and applications of AI. Problem-solving methods, state space search, heuristic search, knowledge representation: predicate logic, resolution, natural deduction, nonmonotonic reasoning, semantic networks, conceptual dependency, frames, scripts, and statistical reasoning; advanced AI topics in game playing, planning, learning, and connectionist models.

490 Topics in Computer Sciences for Undergraduates (1-5 cr.) By arrangement. Supervised reading and reports in various fields. Open to students only with the consent of the department.

Undergraduate and Graduate Level

502 Compiling and Programming Systems (3 cr.) P: 300. R: 470. Basic principles of compilers and compiler design; control of translation, loading, and execution; symbolic coding systems; lexical and syntactic analysis; design and operation of assemblers and macroprocessors; design of interpretive systems. Students are expected to complete a large programming project as part of the course.

503 Operating Systems (3 cr.) P: 403. Basic principles of operating systems: addressing modes, indexing, relative addressing, indirect addressing, stack maintenance; implementation of multitask systems; control and coordination of tasks, deadlocks, synchronization, mutual exclusion; storage management, segmentation, paging, virtual memory, protection, sharing, access control; file systems; resource management; evaluation and prediction of performance.

512 Numerical Methods for Engineers and Scientists (3 cr.) P: MATH 351 or MATH 511; MATH 510; and knowledge of programming. Not open to students with credit in 414. Not

normally accepted for graduate credit in computer science programs. A survey of the useful methods of computation. Solution of nonlinear equations and systems of nonlinear equations. Numerical methods for systems of linear equations. Approximate differentiation and integration. Numerical solution of ordinary differential equations. Introduction to partial differential equations and elementary approximation methods.

514 Numerical Analysis (3 cr.) P: 414 or equivalent. Iterative methods for solving nonlinear equations; linear difference equations; applications to solution of polynomial equations; differentiation and integration formulas; numerical solution of ordinary differential equations; round-off error bounds.

515 Numerical Analysis of Linear Systems (3 cr.) P: Knowledge of programming, and MATH 351 or MATH 511. Computational aspects of linear algebra; linear equations and matrices; direct and iterative methods; eigenvalues and eigenvectors of matrices; error analysis.

516 Computational Methods in Applied Mathematics (3 cr.) P: 265 and MATH 510 or consent of instructor. A study of techniques such as direct integration, shooting, finite difference, finite element, method of weighted residuals, and methods of characteristics for solving problems in fluid mechanics, solid mechanics, dynamics, and other fields of applied mathematics.

520 Computational Methods in Analysis (3 cr.) P: 220 or 230 or equivalent, and MATH 351 or MATH 511. A treatment of numerical algorithms for solving classical problems in real analysis with primary emphasis on linear and nonlinear systems of equations and on optimization problems; the writing, testing, and comparison of numerical software for solving such problems; a discussion on the characteristics of quality software for implementing these algorithms.

536 Data Communication and Computer Networks (3 cr.) P: 402. Data communications: communication hardware technologies including local area and long-haul network hardware, circuit and packet switching, interfaces between computer and network hardware, and performance issues. Network architecture: protocol software and conceptual layering, reliable delivery over an unreliable channel, transport protocols, virtual circuits, datagrams, internet working as a fundamental design concept, the client-server paradigm, naming and name binding, name servers, addressing and address resolution, routing and routing algorithms, congestion and flow control techniques, network file systems, distribution of computation, DARPA Internet protocols (TCP/IP) as examples of protocol organization.

541 Database Systems (3 cr.) P: 443 or equivalent. Fundamentals for the logical design of database systems. The entity-relationship model, semantic model, relational model, hierarchical model, network model. Implementations of the models. Design theory for relational databases. Design of query languages and the use of semantics for query optimization. Design and verification of integrity assertions, and security. Introduction to intelligent query processing and database machines.

543 Introduction to Simulation and Modeling of Computer Systems (3 cr.) P: 265 and STAT 511 or equivalent. Simulation: discrete event simulation, process oriented simulation, generating random numbers, simulation languages, simulation examples of complex systems. Nondeterministic models: random variables, Poisson process, moment generating functions, statistical inference, and data analysis. Modeling: elementary queuing models, network of queues, applications to performance evaluation of computer systems.

547 Information Storage and Retrieval and Natural Language Processing (3 cr.) P: 541. Complex data structures of fields within records, as well as clustered, multilist, and inverted files; key decoding by tree and randomized techniques; overall techniques of classical document retrieval systems, e.g., the MEDLARS and NASA systems; overall techniques of automatic document retrieval systems, e.g., TIP and SMART, the internal structure of SMART; question answering systems; natural language translation.

556 Fault-Tolerant Computing (3 cr.) P: 362. Concepts of fault-tolerant computing; phases of fault-tolerance; applications to commercial, communication, and aerospace systems; fault-tolerance in multiprocessor systems; diagnosis techniques; software fault-tolerance.

565 Programming Languages (3 cr.) P: 300. R: 470. An exploration of modern or unconventional concepts of programming languages, their semantics, and their implementations; program verification using Hoare's logic and Dijkstra's predicate transformers; abstract data types; monitors and distributed processes; LISP; applicative languages and APL; data flow languages.

582 Automata and Formal Languages (3 cr.) P: 470. Finite automata, regular expressions; push-down automata, context-free grammars; their languages and behaviors. Closure properties, pumping lemmas, decision procedures. Deterministic context-free

languages and LR(k) parsing; brief survey of the Chomsky hierarchy.

585 Mathematical Logic I (MATH 585) (3 cr.) Students should register for MATH 585. P: MATH 351. Formal theories for propositional and predicate calculus with study of models, completeness, compactness. Formalization of elementary number theory; Turing machines, halting problem, and the undecidability of arithmetic.

590 Topics in Computer Science (3 cr.) By arrangement. Directed study for students who wish to undertake individual reading and study on approved topics.

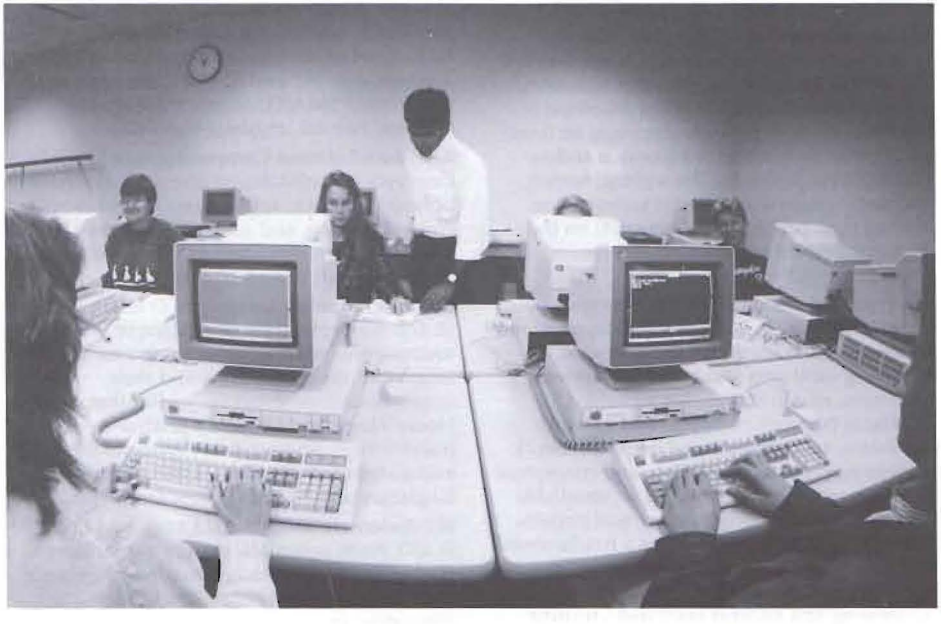
Graduate Level

614 Numerical Solution of Ordinary Differential Equations (3 cr.) P: 514. Numerical solution of initial-value problems by Runge-Kutta methods, general one-step methods, and multistep methods. Analysis of truncation error, discretization error, and rounding error. Stability of multistep methods. Numerical solution of boundary-value and eigenvalue problems by initial-value techniques and finite difference methods.

615 Numerical Solution of Partial Differential Equations (3 cr.) P: 515 and MATH 523. The numerical solution of hyperbolic, parabolic, and elliptic equations by finite difference methods; iterative methods (Gauss-Seidel, overrelaxation, alternating direction) for solving elliptic equations; discretization and round-off errors; explicit and implicit methods for parabolic and hyperbolic systems; the method of characteristics; the concept of stability for initial value problems.

660 Design of Translating Systems (3 cr.) P: 502. Systems design of higher-level programming languages and their processors; symbol tables, lexical scan, syntax scan, object code generation and optimization; boot-strapping techniques, higher-level translators, self-compilers, and decompilers; heuristic generators.

661 Formal Compiling Methods (3 cr.) P: 502. Application of concepts developed in formal language and automata theory to the design of programming languages and their processors. Models of syntactic analysis, including canonical precedence, LR(k) and LL(k) parsing methods and variants; efficiency of each. Synthesis techniques, including symbol tables, storage administration, parameter mechanisms, garbage collection; optimization considerations. Models of synthesis, including level, affix, attributed grammars; prospects of fully automating compiler design. Application vs. procedural languages and their implementations based on semantic definition of a language (LISP, Lucid) and on proof-like techniques (PROLOG, equational systems); merits of such approaches.



Department of Geology

Professor Mirsky (*Chairperson*)
Associate Professors de Caprariis, Hall, Pachut, Rosenberg
Assistant Professors Barth, Tedesco
Adjunct Professors Banaszak, Ghosh, Haitjema, Prezbindowski, Robinson
Departmental Academic Advisers Hall, Mirsky

Geology is the science of the earth—the systematic attempt by humans to understand the planet and the environment in which they dwell. Geology includes the location, extraction, and economic use of minerals, rocks, soils, water, coal, and petroleum. These natural resources compose the earth and make possible our modern technology and civilization. Geologists study the landforms produced by volcanoes, streams, winds, glaciers, and other surficial earth processes. They investigate the internal earth processes of earthquakes, mountain building, continental drift, and sea-floor spreading. Geology includes the fossils that record the development of life on the earth and also includes the investigation of the billions of years of earth history. Geology has recently expanded to include the study of the moon and the other planets in the solar system.

The Department of Geology furnishes training for (1) those who desire to become professional geologists and seek careers in industry, in research laboratories, in federal or state or local government, or in university or college teaching; (2) those who wish to teach earth science or geology at the secondary school level; and (3) those who seek a general knowledge of geology, its relationship to other sciences, and its importance to the environment in which we live.

The following undergraduate degree options are offered in geology: Bachelor of Arts (B.A.) in geology (with General Geology Option or Earth Science Secondary Teaching Certification Option), and Bachelor of Science in Geology (B.S. in Geology). The choice of a particular degree option and proposed plan of study must be made in consultation with a departmental adviser. A graduate program leads to the Master of Science (M.S.) degree with options in environmental geology or geologic environmental resources management.

Bachelor of Arts

(Granted by Indiana University)

GENERAL GEOLOGY OPTION

Degree Requirements

Area I See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree" in this bulletin. The second semester of English composition may be satisfied by ENG W132 (or ENG W150) or ENG W231. GEOL G205 may partially satisfy this requirement in Area I, but the 3 credit hours cannot then also be counted as part of the geology credit hours required in Area IV.

Area II There is no foreign language requirement.

Area IIIA See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree" in this bulletin. First year of a foreign language does not apply toward satisfying this requirement.

Area IIIB See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree" in this bulletin.

Area IIIC Physical and Biological Sciences See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree" in this bulletin, but all four courses must include a laboratory, and at least two of the four courses must include CHEM C105-C106, and at least one of the four courses must be in biological sciences. No grade below C– will be accepted in chemistry or in the other two courses to satisfy Area IIIC.

Area IIID Mathematical Sciences MATH 153-154 or MATH 151; and CSCI 220 or CSCI 207. No grade below C– will be accepted in any of these courses.

Area IV Geology Concentration Requirements 37 credit hours of geology, including G109, G110, G119, G205, G206, G221, G222, G303, G323, G334, G404, G494, and two courses from among 400-level or higher geology electives (but note that G409 or G410 must each total at least 3 credit hours to be used in place of one—and only one—of these two 400-level courses). A maximum of 2 credit hours of G420 and/or the special 3 credit G420 Regional Geology Field Trip: Field Exercises may be counted toward the geology concentration of 37 credit hours, but G420 may not substitute for either of the two courses from among 400-level or higher geology electives noted above. GEOL G107, G115, and G130 do not count towards the geology concentration of 37 credit hours but may be applied as electives towards the university-required total of 122 credit hours. No grade below C– will be accepted in any of these geology courses. Note that G205 is a prerequisite for all 300- and 400-level courses. This program can provide a broad, general education and often an adequate background for professional employment in geology.

Other Requirements

See the School of Science requirements under "Undergraduate Programs, Baccalaureate Degree, General Requirements" in this bulletin. The Department of Geology will accept 10 credit hours toward graduation outside the Schools of Science and Liberal Arts.

EARTH SCIENCE SECONDARY TEACHING CERTIFICATION OPTION

Degree Requirements

A. **Humanities** 18-24 credit hours.
   Area I For teacher certification the requirement is met by the School of Science requirement. The second course in English composition may be satisfied by ENG W132 (or ENG W150) or ENG W231. GEOL G205 may partially satisfy this requirement, but the 3 credit hours cannot then also be counted as part of the geology credit hours required in Area IV.
   Area II There is no foreign language requirement.
   Area IIIA See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree" in this bulletin. First year of a foreign language does not apply toward satisfying this requirement.
B. **Social and Behavioral Sciences** 9-15 credit hours.
   Area IIIB See the School of Science requirements.
C. **Life and Physical Sciences** 9-15 credit hours.
   Areas IIIC and IIID Same as under General Geology Option above.
D. **Electives** as needed to obtain a total of 40 credit hours. Must include CSCI 220 or CSCI 207.

Earth Science Requirements (Area IV)

51 credit hours of geology and related subjects (including GEOL G109, G110, G119, G205, G206, G221, G222, G303, G323, G334, G404, G494) and CHEM C105-C106. No grade below C– will be accepted in geology and chemistry. The additional related subjects are chosen from among those courses listed in the certification requirements below.

Certification Requirements

Certification in science requires both a primary and support teaching area. Students pursuing the Earth Science Secondary Teaching Certification Option would earn a primary area of earth science and must choose a supporting area of either physical science or physics.

The requirements for a supporting area of physical science are 8-10 credit hours of chemistry and 5-7 credit hours of physics, or 8-10 credit hours of physics and 5-7 credit hours of chemistry. The support area must total at least 15 credit hours of course work.

The courses required for a supporting area of physics are PHYS 218-219 or PHYS 152-251, and 300-level physics electives to total 15 credit hours of physics.

In addition, general requirements for students seeking a science teaching major include nutrition, pharmacology, and in the case of an earth science primary area, one course in biology.

Students seeking a primary area of earth science must take GEOL G300 or GEOG G315 and GEOL G416 in addition to the geology courses required of the baccalaureate degree.

The student should consult with a geology adviser for further information regarding courses to complete the certification requirements.

Professional Education Requirements

Refer to the front section of this bulletin under "Special Programs, Teacher's Certificate."

Other Requirements

Follow the School of Science requirements under "Undergraduate Programs, Baccalaureate Degree, General Requirements" in this bulletin, with the exception that students will need electives to make a minimum of 124 credit hours, and an average grade of C+ or better for education courses (with at least a C in each course). The Department of Geology will accept 10 credit hours toward graduation outside the Schools of Science, Liberal Arts, and Education.

Bachelor of Science

(Granted by Indiana University)

Degree Requirements

Area I See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree" in this bulletin. The second semester of English composition may be satisfied by ENG W132 (or ENG W150) or ENG W231. GEOL G205 may partially satisfy this requirement in Area I, but the 3 credit hours cannot then also be counted as part of the geology credit hours required in Area IV.

Area II There is no foreign language requirement.

Area IIIA See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree" in this bulletin. First year of a foreign language does not apply toward satisfying this requirement.

Area IIIB See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree" in this bulletin.

Area IIIC Physical and Biological Sciences CHEM C105-C106; PHYS P201-P202 or 152-251; and two courses in biological sciences, with Department of Geology's approval. No grade below C– will be accepted in any of these courses.

Area IIID Mathematical Sciences MATH 163-164; CSCI 220 or CSCI 230; and one course in statistics with departmental approval. No grade below C– will be accepted in any of these courses.

Area IV Geology Concentration Requirements Geology: 44 credit hours including GEOL G109, G110, G119, G205, G206, G221, G222, G303, G323, G334, G404, G429 (or equivalent), G494, and two courses from among 400-level or higher geology electives (but note that G409 or G410 must total at least 3 credit hours to be used in place of one—and only one—of these two 400-level courses). A maximum of 2 credit hours of G420 and/or the special 3 credit G420 Regional Geology Field Trip: Field Exercises may be counted toward the geology concentration of 44 credit hours, but G420 may not substitute for either of the two courses from among 400-level or higher geology electives noted above. GEOL G107, G115, and G130 do not count toward the geology concentration of 44 credit hours, but may be applied as electives toward the university-required total of 122 credit hours. No grade below C– will be accepted in any of these geology courses.

General Two courses at 300-400 level in one or more of the following departments: biological sciences, chemistry, computer and information science (with consent of the Department of Geology), mathematical sciences, and physics. With departmental approval, a third 400-level geology elective may substitute for one of these two courses. No grade below C– will be accepted in any of these courses.

Other Requirements

See the School of Science requirements under "Undergraduate Programs, Baccalaureate Degree, General Requirements" in this bulletin. The Department of Geology will accept 10 credit hours toward graduation outside the Schools of Science and Liberal Arts.

Minor in Geology

(Granted by Indiana University)

The minor in geology requires 24 credit hours of geology courses, with an overall grade point average of 2.0 (C) and with no grade less than a C–, distributed as follows:

1. Students must complete 14 credit hours of course work in geology, including G109 (3 cr.), G119 (1 cr.), G110 (3 cr.), G206 (1 cr.), G221 (3 cr.), and G222 (3 cr.).

2. Students must complete an additional 10 credit hours minimum, including three of the following courses: G303 (4 cr.), G323 (3 cr.), G334 (3 cr.), and G404 (3 cr.)-G410 (1 cr.) (Note that G404-G410 counts as one selection.)

At least 9 credit hours of the minor must be taken at IUPUI. In addition, recommended courses include one year of college chemistry and at least one course in college algebra. Correspondence courses may not be used to fulfill requirements for the minor.

Geology Plans of Study

There is no single semester-by-semester plan of study for any of the three baccalaureate degree options because of the flexibility encouraged within the program for each option. However, one possible sequence of courses for each option is given below; variations from these samples of plans of study should be made in consultation with a departmental adviser.

Bachelor of Arts, General Geology Option (122 cr.)

Freshman Year

First Semester		Second Semester	
GEOL G110 The Earth's Environment	3	**GEOL G109** Evolution of the Earth	3
GEOL G206 Physical Geology Laboratory	1	**GEOL G119** Evolution of the Earth Laboratory	1
CHEM C105 Principles of Chemistry I	5	**CHEM C106** Principles of Chemistry II	5
ENG W131 Elementary Composition I	3	**MATH 154** Algebra and Trigonometry II	3
MATH 153 Algebra and Trigonometry I	3	Second Composition Course	3
	15		15

Sophomore Year

Third Semester		Fourth Semester	
GEOL G221 Introductory Mineralogy	3	**GEOL G205** Reporting Skills in Geoscience	3
BIOL N107 Introduction to Zoology	4	**GEOL G222** Introductory Petrology	3
COMM C110 Fundamentals of Speech Communication	3	**BIOL K101** Concepts of Biology I—Plants	5
Arts and Humanities Elective	3	Arts and Humanities Elective	3
Social and Behavioral Sciences Elective	3		14
	16		

Junior Year

Fifth Semester		Sixth Semester	
GEOL G303 Geologic Mapping and Field Methods	4	**GEOL G323** Structural Geology	3
GEOL G334 Principles of Sedimentation and Stratigraphy	3	**CSCI 220** Problem Solving with Computers	3
Arts and Humanities Elective	3	Arts and Humanities Elective	3
Social and Behavioral Sciences Elective	3	Social and Behavioral Sciences Elective	3
Elective	3	Elective	3
	16		15

Senior Year

Seventh Semester		Eighth Semester	
GEOL G404 Geobiology	3	**GEOL G494** Senior Project in Geology	0
GEOL G410 Undergraduate Research in Geobiology	1	**GEOL** 400-level Elective	3
GEOL 400-level Elective	3	300-level Electives	9
300-level Elective	3	Elective	3
Social and Behavioral Sciences Elective	3		15
Elective	3		
	16		

Bachelor of Arts, Earth Science Secondary Teaching Certification Option (138 cr.)

Freshman Year

First Semester

GEOL G110 The Earth's Environment 3
GEOL G206 Physical Geology Laboratory 1
ENG W131 Elementary Composition I 3
MATH 153 Algebra and Trigonometry I 3
Arts and Humanities Elective 3
Social and Behavioral Sciences Elective 3
16

Second Semester

GEOL G109 Evolution of the Earth 3
GEOL G119 Evolution of the Earth Laboratory 1
BIOL N107 Introduction to Zoology 4
HPER H318 Drug Use in American Society 3
MATH 154 Algebra and Trigonometry II 3
Second Composition Course 3
17

Sophomore Year

Third Semester

GEOL G221 Introductory Mineralogy 3
CHEM C105 Principles of Chemistry I 5
COMM C110 Fundamentals of Speech Communication 3
EDUC H340 Education and American Culture 3
FN 303 Essentials of Nutrition 3
17

Fourth Semester

GEOL G205 Reporting Skills in Geoscience 3
GEOL G222 Introductory Petrology 3
CHEM C106 Principles of Chemistry II 5
EDUC M201 Field Experience 1
EDUC P255 Educational Psychology 3
EDUC W200 Microcomputing for Education 1
16

Junior Year

Fifth Semester

GEOL G303 Geologic Mapping and Field Methods 4
GEOL G334 Principles of Sedimentation and Stratigraphy 3
AST A100 The Solar System *or*
AST A105 Stellar Astronomy 3
EDUC M300 Teaching in a Pluralistic Society 3
EDUC M301 Field Experience 0
EDUC M314 General Methods for Senior High/Junior High/Middle School Teachers 3
16

Sixth Semester

GEOL G115 Introduction to Oceanography 3
GEOL G323 Structural Geology 3
CSCI 207 Computers in the Social Sciences *or*
CSCI 220 Problem Solving with Computers 3
EDUC M464 Methods of Teaching Reading 3
GEOG G315 Environmental Conservation 3
15

Senior Year

Seventh Semester

GEOL G404 Geobiology 3
GEOL G410 Undergraduate Research in Geobiology 1
GEOG G304 Meteorology 3
EDUC M403 Field Experience 0
EDUC M446 Methods of Teaching Senior High/Junior High/Middle School Science 4
GEOL 400-level Elective 3
14

Eighth Semester

EDUC M480 Student Teaching: Secondary 9
GEOL G494 Senior Project in Geology 0
GEOL 400-level Elective 3
12

Summer Session (Sophomore and/or Junior Year)

Arts and Humanities Electives 9
Social and Behavioral Sciences Electives 6
15

Bachelor of Science (124 cr.)

Freshman Year

First Semester		Second Semester	
GEOL G110 The Earth's Environment	3	**GEOL G109** Evolution of the Earth	3
GEOL G206 Physical Geology Laboratory	1	**GEOL G119** Evolution of the Earth Laboratory	1
ENG W131 Elementary Composition I	3	**CHEM C105** Principles of Chemistry I	5
MATH 153 Algebra and Trigonometry I	3	**MATH 154** Algebra and Trigonometry II	3
Arts and Humanities Elective	3	Second Composition Course	3
	13		16

Sophomore Year

Third Semester		Fourth Semester	
GEOL G221 Introductory Mineralogy	3	**GEOL G205** Reporting Skills in Geoscience	3
CHEM C106 Principles of Chemistry II	5	**GEOL G222** Introductory Petrology	3
COMM C110 Fundamentals of Speech Communication	3	**BIOL N107** Introduction to Zoology	4
MATH 163 Integrated Calculus and Analytic Geometry I	5	**MATH 164** Integrated Calculus and Analytic Geometry II	5
	16		15

Junior Year

Fifth Semester		Sixth Semester	
GEOL G303 Geologic Mapping and Field Methods	4	**GEOL G323** Structural Geology	3
GEOL G334 Principles of Sedimentation and Stratigraphy	3	**BIOL K101** Concepts of Biology I—Plants	5
CSCI 220 Problem Solving with Computers	3	**PHYS 251** Heat, Electricity, and Optics	5
PHYS 152 Mechanics	4	**STAT 301** Elementary Statistical Methods I	3
	14		16

Senior Year

Seventh Semester		Eighth Semester	
GEOL G404 Geobiology	3	**GEOL G494** Senior Project in Geology	0
GEOL G410 Undergraduate Research in Geobiology	1	**GEOL** 400-level Elective	3
GEOL 400-level Elective	3	300–400-level non-Geology Science Elective	3
300–400-level non-Geology Science Elective	3	Arts and Humanities Elective	3
Social and Behavioral Sciences Elective	3	Social and Behavioral Sciences Elective	3
	13	Elective	3
			15

Summer Session (Sophomore or Junior Year)
GEOL G429 Field Geology in the Rocky Mountains 7

Master of Science

(Granted by Indiana University)

The Department of Geology graduate program leads to the Master of Science degree with options in environmental geology and in geologic environmental resources management. The Master of Science degree program is administered under the chairperson by a graduate advisory committee composed of a graduate adviser and two graduate committee members appointed by the chairperson.

Admission Requirements

The prospective student in the master's program should have a baccalaureate degree in geology, including summer field camp, and a 3.0 (B) grade point average in geology courses. Also, for the Environmental Geology Option, requirements include one year each of chemistry and physics,

mathematics through calculus, a course in statistics, and a course in computer programming. For the Geologic Environmental Resources Management Option, one year of chemistry, mathematics through college algebra and trigonometry, a course in statistics, and a course in computer programming are required. Each candidate may submit Graduate Record Examination scores (on both the General Aptitude Test and the subject test in geology) but must submit three letters of recommendation. Persons with a baccalaureate degree in another area of science are also encouraged to apply; a special admissions committee will prescribe a plan of study to remove deficiencies.

Transfer Credit

The Department of Geology will accept by transfer a maximum of 8 hours of graduate credit, in excess of undergraduate degree requirements, from approved institutions.

Grades

A 3.0 (B) grade point average or higher must be maintained, but no more than 6 credit hours of grades below B are acceptable and no grade below C is acceptable.

Financial Aid

Qualified candidates for the master's degree may be appointed as part-time lecturers in introductory-level courses. Several such positions are available each semester. Teaching positions include remission of about 80 percent of fees and tuition. In addition, grant-supported research assistantships may be available to exceptionally well-qualified candidates. Finally, all candidates may apply for University Fellowships.

ENVIRONMENTAL GEOLOGY OPTION

Both thesis and nonthesis options are available.

1. The thesis option requires a minimum of 30 credit hours, including 6 credit hours for the thesis.
2. The nonthesis option requires a minimum of 36 credit hours, 3 of which must be in a research course requiring a written report. Students electing the nonthesis option also must include among the 36 credit hours 6 credit hours in research skill courses (e.g., computer science, statistics, etc.).
3. Both thesis and nonthesis options require at least 6 credit hours in allied science and mathematics courses approved for graduate credit. Up to 6 credit hours of 400-level (senior) geology courses approved for graduate credit may count toward major field requirements.

GEOLOGIC ENVIRONMENTAL RESOURCES MANAGEMENT OPTION

The program requires 36 credit hours, distributed as follows:

1. 15 credit hours (at least 5 courses) selected from approved graduate-level geology courses.
2. 12 credit hours (at least 4 courses) selected from approved graduate-level School of Public and Environmental Affairs (SPEA) courses.
3. 6 credit hours (at least 2 courses) of electives selected with approval of advisory committee from among graduate-level courses outside geology and SPEA.
4. 3 credit hours (at least 1 course) of a practicum taken in the last semester in G700 (Geologic Problems).

With approval, up to 6 credit hours of 400-level geology courses approved for graduate credit may apply toward the 15 geology credits.

Courses in Geology (GEOL)

Courses with numbers in the 100s and 200s are lower-division undergraduate courses. Courses with numbers in the 300s and 400s are upper-division undergraduate courses that may, in some cases, be used for graduate credit. Courses in the 300s may be used for graduate credit by graduate students in education but not by other students. Courses in the 400s may be taken for graduate credit by all graduate students. Courses numbered 500 or higher are graduate courses.

Note: P—prerequisite; C—corequisite; R—recommended; Fall—offered fall semester; Spring—offered spring semester; Summer—offered in the summer session; Day—offered as a daytime section; Night—offered as an evening section. For courses with no designated semester or section, consult the *Schedule of Classes*.

G107 Environmental Geology (3 cr.) P: None. Fall, Spring, Summer. An introduction to geology through discussion of geological topics that show the influence of geology on modern society. Topics include mineral and energy resources, land use, water supplies, geologic hazards and problems, geology and health, and new geological developments.

G109 Geology: Evolution of the Earth (3 cr.) P: None. Fall, Spring, Summer. Basic principles of interpreting earth history: geologic time, stratigraphic analysis, reconstructing past environments. Physical development of the earth: its interior, mountain building, continental drift, sea-floor spreading. Origin and development of life: evolution, the fossil record. With laboratory G119, equivalent to IU GEOL G104, IU GEOL G112, and PU GEOS 112.

G110 Geology: The Earth's Environment (3 cr.) P: None. Fall, Spring, Summer. Description, classification, and origin of minerals and rocks. Internal processes: earthquakes, rock deformation, origin of crustal structures. External processes: landslides, streams, glaciers, groundwater, humans' geologic environment. With laboratory G120, equivalent to IU GEOL G103, IU GEOL G111, and PU GEOS 111.

G115 Introduction to Oceanography (3 cr.) P: None. Fall, Spring, Summer. Nonmathematical introduction to the history, geology, biology, and physical characteristics of the ocean. Includes volcanoes and earthquakes in the marine environment, currents of the world ocean, the life history of marine animals, and pollution of the marine ecosystem.

G119 Evolution of the Earth Laboratory (1 cr.) C: G109. Fall, Spring, Summer. Laboratory studies of fossils and stratigraphic analysis to reconstruct past environments and interpret earth history. To accompany G109.

G120 The Earth's Environment Laboratory (1 cr.) C: G110. Fall, Spring, Summer. Laboratory studies of minerals and rocks, landscapes, and earth structures. To accompany G110.

G130 Short Courses in Earth Science (topic varies) (1 cr.) P: None. Five-week short courses on a variety of topics in the earth sciences. Examples of topics include: lunar and planetary geology; geology of Indiana; geology of national parks; glaciers; geology of cities; geology of gemstones; geology of art; energy; history of geology; earthquakes; volcanoes; prehistoric life; dinosaurs; fossil clocks and changing time. Each short course is one credit; no topic may be taken for credit more than once.

G205 Reporting Skills in Geoscience (3 cr.) P: G109 or G110, and ENG W131. Spring. Techniques of presenting written and oral reports from the geoscience approach. The written report: mechanics of format and illustrations, proper citation of geoscience literature, the abstract, proofreading, and editing. The oral report: effective presentation and response to audience questions, simulating a professional science meeting.

G206 Physical Geology Laboratory (1 cr.) P or C: G110. Fall, Spring. The laboratory study of minerals, rocks, topographic maps and aerial photographs, landforms and landscapes, structural geology, and geologic maps.

G221 Introductory Mineralogy (3 cr.) P: G206 and CHEM C105, or consent of instructor. Fall. Crystallography: symmetry, morphology, classes. Mineral chemistry, physics, and genesis. Description, identification, association, occurrence, and use of common and important minerals.

G222 Introductory Petrology (3 cr.) P: G221 and CHEM C106. Spring. Igneous, sedimentary, and metamorphic rocks: composition, field occurrence, characteristics, classification, origin, laboratory description and identification.

G300 Environmental and Urban Geology (3 cr.) P: G107 or G110 or consent of instructor. Significance of regional and local geologic features and geologic processes in land-use planning; use of geologic data in areas of rapid urbanization to properly utilize mineral and water resources and to assess potential geologic hazards.

G303 Geologic Mapping and Field Methods (4 cr.) P: G205 and G222, or consent of instructor. Pace-and-compass and plane-table mapping. Measuring and describing stratigraphic sections of sedimentary rocks and surficial deposits. Mapping geologic structures and structural interpretation of maps and aerial photographs. Environmental (land-use) mapping.

G309 Cooperative Education in Geology (1-3 cr.) P: G206, G222, G303. Industrial or government or similar experiences in geologically oriented employment. Grade is determined on basis of a written student report and a supervisor evaluation report. May be repeated for a maximum of 6 credit hours.

G323 Structural Geology (3 cr.) P: G205, G206, G222. R: G303. Nature and origin of primary and secondary structural features of the earth's crust, with emphasis on mechanics of deformation and origin, and three-dimensional problems illustrating structural concepts.

G334 Principles of Sedimentation and Stratigraphy (3 cr.) P: G205 and G222. P or C: G303. Spring. Interrelationship of sedimentation and stratigraphy: processes and factors influencing genesis of sedimentary strata; provenance, depositional environment, sedimentary facies, paleoecology; analytical techniques, application of principles to interpretation of stratigraphic record.

G403 Optical Mineralogy and Petrography (3 cr.) P: G205, G222. Identification of rock-forming minerals in fragments and thin-sections using principles of optical crystallography and the standard petrographic microscope. Description of common igneous, sedimentary, and metamorphic rocks and interpretation of their genesis using hand-specimens and thin-sections. Practical applications are considered.

G404 Geobiology (3 cr.) P: G109-G119, G205, and G222, and BIOL K101 or BIOL K103 or BIOL N107, or consent of instructor. Fall. Principles of paleontology. Application of biological principles and use of fossils in the study of earth history. Emphasis is on documentation of macroevolution and development of the basic theory of evolution. Laboratory exercises examine the form and ecology of major phyla with a fossil record. G410 (1 cr.) must be taken concurrently for field project by geology majors; optional for nonmajors.

G406 Introduction to Geochemistry (3 cr.) P: G205, G221, and CHEM C106, or consent of instructor. Chemistry in the study of the earth employing elementary chemical thermodynamics, the phase rule, chemical equilibria, redox reactions, the radioactive decay law, and organic chemistry.

G409 Independent Study in Geology (1-3 cr.) P: Consent of instructor. Fall, day, night; Spring, day, night; Summer, day, night. Supervised independent study of topics and techniques in geology that are not available in formal courses in the department.

G410 Undergraduate Research in Geology (1-6 cr.) P: G205, junior standing, and consent of instructor. Fall, day, night; Spring, day, night; Summer, day, night. Field and laboratory research in selected problems in geology. May be repeated. Total of 6 credit hours may be applied toward the degree.

G413 Introduction to Geophysics (3 cr.) P: G205 and consent of instructor. Physics in the study of the earth, its origins, history, and internal constitution. Exploration techniques.

G415 Principles of Geomorphology (4 cr.) P: G205, G222, G303, G323. P or C: G334. Natural processes that create landforms and landscapes. Physics and chemistry of weathering and soil formation. Dynamics of mass wasting, streams, glaciers, wind, and shoreline processes. Includes field and laboratory investigations and a research project on a selected aspect of geomorphology.

G416 Economic Geology (3 cr.) P: G205 and G222, or consent of instructor. Origin, geologic occurrence, distribution, use, and conservation of important geologic natural resources of the world. Metallic minerals; industrial minerals and rocks; coal, petroleum, natural gas, and other energy resources; water as a natural resource. Credit not given for both G416 and G316.

G420 Regional Geology Field Trip (1-3 cr.) P: G205 or consent of instructor. Seminar and field investigation of selected regions for study of mineralogic, lithologic, stratigraphic, structural, paleontologic, geomorphologic, or other geological relationships. Seminar held during spring semester. Six to 21 days in the field during summer session.

G429 Field Geology in the Rocky Mountains (7 cr.) P: G205, G221, G222, G303, G323, and G334. Summer. Seven weeks at Geologic Field Station in Montana. Geologic reconnaissance, measurement of stratigraphic sections, mapping on aerial photographs, construction of structure sections. Regional geomorphology, stratigraphy, and structure through South Dakota, the Black Hills, Wyoming, Montana, Yellowstone National Park, and Glacier National Park. Students register through the Department of Geology at Indiana University Bloomington.

G430 Principles of Hydrology (4 cr.) P: G205, G206, MATH 148, CHEM C106, PHYS P202 or PHYS 251, and introductory biology. Introduction to the study of surface and subsurface water and water quality. Includes

field and laboratory investigations and a research project integrating geologic and hydrologic characteristics of selected areas in central Indiana.

G445 Applied Analytical Techniques in Geology (3 cr.) P: G221, CHEM C105-106, and consent of instructor. Principles of X-ray diffractometry, electron microprobe analysis, atomic absorption spectrophotometry, cathodoluminescence microscopy, and scanning electron microscopy with applications to the earth sciences. Lectures on theory are followed by hands-on laboratory exercises. *G445 is available for undergraduate students only.*

G451 Principles of Hydrogeology (3 cr.) P: G205 and G110, or consent of instructor. R: G334. Water resources; occurrence, regulation, and management of water; hydrologic cycle, water movement, water quality and pollution; surface and subsurface investigations; basinwide development of water resources.

G490 Seminar in Geology (2-3 cr.) P: Junior or senior standing and consent of instructor. Readings and discussion of selected topics. May be repeated, provided different topics are studied, for a maximum of 6 credit hours.

G494 Senior Project in Geology (0 cr.) Final assessment project required of all geology graduating seniors. Those graduating in December should enroll in the fall semester; those graduating in May or August should enroll in the spring semester.

G499 Honors Research in Geology (3 cr.) P: Approval of departmental Honors Committee.

Graduate Courses[1]

G511 Stratigraphy of North America (3 cr.) P: G334 and G404, or equivalent. Lithostratigraphy, biostratigraphy, correlation, tectonic setting, and depositional environment of North American Phanerozoic rocks.

G525 Glacial Geology (3 cr.) P: G415 or consent of instructor. Formation, dynamics, and regimen of glaciers. Erosional and depositional processes and landforms. Glaciation of North America with emphasis on stratigraphy, soils, climates, and physical changes resulting from glacial processes and environments. Field investigations and a student research project are required.

G545 Applied Analytical Techniques in Geology (3 cr.) P: G221, CHEM C105-106, and consent of instructor. Principles of X-ray diffractometry, electron microprobe analysis, atomic absorption spectrophotometry, cathodoluminescence microscopy, and scanning electron microscopy with applications to the earth sciences. Lectures on theory are followed by hands-on laboratory exercises. Each student will complete an individual research project. *Credit will not be given for both G445 and G545.*

G551 Advanced Hydrogeology (3 cr.) P: G430 or G451. Basic principles and quantitative aspects of physical flow systems and chemistry of ground water and surface water. The relationships between water and geologic materials.

G561 Paleoecology (3 cr.) P: G334 and G404. Relationships between modern and fossil organisms and their physical, chemical, and biological environments; emphasis on techniques for interpreting past environmental conditions.

G585 Environmental Geochemistry (3 cr.) P: Consent of instructor. Application of organic geochemical methods in determining origins of fossil fuels and in defining biological and environmental histories of rocks.

G595 Data Analysis Techniques in Geoscience (3 cr.) P: STAT 301 and CSCI 220, or equivalent. Application of statistical and numerical analysis techniques to geoscience data, including error analysis, confidence intervals, least squares methods, correlation, time series analysis, and cluster analysis. Use of the computer to solve geoscience problems is emphasized, including petrological calculations and graphical displays.

G596 Topics in Applied Environmental Geology (3 cr.) P: consent of instructor. Application of geologic principles to common environmental problems. Topics include data collection for site investigations, soil and rock mechanics, seismology, and hydrogeology. Application of principles to problems such as soil foundations, slope stability, earthquake-resistant design, and design of landfills.

G621 Modeling Hydrological Systems (3 cr.) P: G430 and consent of instructor. A number of approaches to modeling hydrological systems are considered. Particular attention is paid to the modeling of transient saturated-unsaturated subsurface flow, as well as to modeling of overland flow and stream flow. Modeling of contaminant transfer is also considered.

G622 Urban Geology (3 cr.) P: Consent of instructor. Consideration of geologic factors in land-use planning in the urban setting. Availability and use of geologic resources, building and road materials, water supply, waste disposal, and geologic hazards. Emphasis on applications of principles to problem solving.

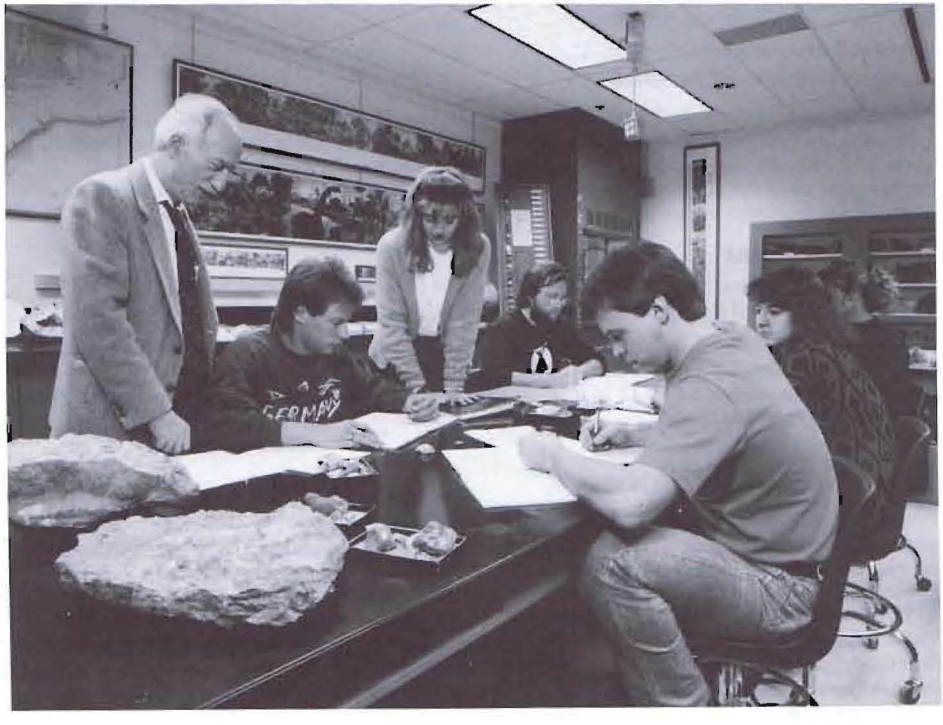
[1]These courses are currently available. Other courses are being proposed to complement the program..

G635 Soil Geomorphology (3 cr.) P: G415. Application of geomorphic principles in evaluation of weathering and soil formation, systems analysis of soil-landscape models, present and past environments, paleogeomorphology and paleopedology, lecture discussion, field and laboratory problems.

G690 Advanced Geology Seminar (cr. arr.) P: Consent of instructor.

G700 Geologic Problems (1-5 cr.) P: Consent of instructor. Consideration of special geologic problems.

G810 Thesis Research (6 cr.)



Department of Mathematical Sciences

Professors Aliprantis, Bittinger, Burkinshaw, Kaminker, Kleyle, Kuczkowski, Misiurewicz, Ng *(Chairperson)*, Penna, Rothman

Professors Emeriti Alton, Crown, Johnston, Sconce

Associate Professors Abramovich, Frankel, Hutton, Luke, Miller (IUPUI Columbus), Morrel, Patterson, Rigdon, Sen, Tam

Assistant Professors Boukai, Cox, Ji, Klimek, Liu, Sarkar, Wang, Watt, Wojcieckowski, Yan, Ziemian

Adjunct Professor Reid

Lecturers Frantz, Jones, Rangazas

Mathematical sciences includes the areas of pure and applied mathematics, mathematics education, and statistics. Mathematics involves the study of problems in areas such as algebra, geometry, analysis, and logic, and of problems arising in the real world. Mathematics and statistics are used in the physical sciences, engineering, and the social, life, and management sciences. Mathematics education involves the training of prospective secondary teachers.

Degree Programs

The department offers the Bachelor of Science degree in mathematics with options in pure mathematics, applied mathematics, and secondary school teaching.

Graduate degrees offered include the Master of Science, Master of Science (Option for Teachers), and Master of Science (Concentration in Applied Statistics). Additionally, qualified students may be authorized to pursue the Ph.D. in mathematics in areas where a program has been arranged with Purdue, West Lafayette.

Bachelor of Science

In order to receive proper academic advising, a student is encouraged to declare a mathematics major in the freshman year. A grade point average of 2.5 with no failing grades in mathematics courses through MATH 351 is a minimum indication of success in this major.

Degree Requirements

The baccalaureate degree general requirements, the area requirements, and the Bachelor of Science degree requirements are listed earlier in this bulletin (see "Undergraduate Programs"). For a Bachelor of Science degree in mathematics, the following additional requirements and restrictions apply:

Area I There is no additional requirement. The second semester of English composition may be satisfied by ENG W132 (or ENG W150), ENG W231, TCM 220, or TCM 320.

Area II All degree options require 5 credit hours in a modern foreign language.

Area III The following apply to all degree options:

1. Mathematics courses below MATH 163 and those mathematics courses in which the student has received grades below C– do not count toward the degree.
2. Courses that are primarily mathematical may not be used to fulfill the arts and humanities requirement, Area IIIA, or the social and behavioral science requirement, Area IIIB, of the School of Science. If in doubt about a particular course, the student should consult a mathematics department adviser.
3. Certain courses, such as CHEM C101, C102; PHYS 100, 200, 218, 219, P201, P202; AST A100, A105; and GEOL G107, may not be used to fulfill the science requirement, Area IIIC, of the School of Science. If in doubt about a particular course, the student should consult a mathematics department adviser.
4. The Area IIID computer science requirement must be in a higher-level programming course (not BASIC). A grade of C (2.0) or better is required.

Area IV Mathematics courses in which a student has received grades below C (2.0) do not count in area IV. The Area IV requirements for the secondary area of concentration and the major for the three degree options are described in the following sections. There is no single semester-by-semester plan of study for any of the options because flexibility is encouraged within the various

programs. However, a sample program that shows one possible sequence of courses is given for each option. Variations from the sample program should be made in consultation with the student's adviser. Because of the complexity of the above requirements, and because certain courses are not offered every semester, it is important that each student consult the assigned adviser as soon as possible in order to proceed through a proper plan of study for the chosen degree program. A minimum of a 2.5 grade point average in all mathematics courses that count toward the major is required.

Area IV Secondary Area of Concentration Requirements

In order that each student acquire some depth of study in a subject outside of the major area, the Department of Mathematical Sciences requires the student to have a secondary area of concentration in an area outside of the department. The secondary area of concentration consists of at least 18 credit hours and includes at least three courses beyond the introductory level. It is subject to the approval of the student's adviser. Although a secondary area of concentration is usually in one department, it may be from two or more if the adviser approves.

Courses may be used for the double purpose of fulfilling the general requirements and also fulfilling the secondary area of concentration requirements of the Department of Mathematical Sciences. For students in the Pure Mathematics Option or the Applied Mathematics Option, a secondary area in one of the physical sciences or in a subject that makes serious use of mathematics, such as computer science, engineering, or economics, is desirable. Students in the Secondary School Teaching Option satisfy the requirements for a secondary area by the sequence of courses that they take to meet the professional education requirement.

The requirement of 18 credit hours in a secondary area of concentration does not, by itself, constitute an official minor that would be acknowledged on the student's transcript. A minor must be offered through the department or school in which the minor is taken. One such minor, which is designed to be of particular interest to students choosing a career in actuarial sciences, is offered by the School of Business in conjunction with the Department of Mathematical Sciences. Students interested in the business minor for mathematics majors should contact the Department of Mathematical Sciences or the School of Business for exact requirements.

Area IV Major Requirements

PURE MATHEMATICS OPTION

With this option students will be well prepared for graduate work in pure mathematics. However, students with undergraduate degrees in pure mathematics have also been successful with graduate studies in business administration, computer science, economics, engineering, educational research, law, medicine, operations research, psychology, statistics, and physics. Persons with advanced degrees in pure mathematics find careers primarily in college teaching, but careers in business, industry, or government service are also possible.

The Area IV major requirements are as follows:

1. Core curriculum: MATH 163, 164, 261, 262, and 351.
2. Analysis: MATH 441-442.
3. MATH 453 Abstract Algebra.
4. MATH 462 Elementary Differential Geometry *or* MATH 510 Vector Calculus.
5. 12 additional credit hours in mathematics or statistics courses at the 300 level or higher. Courses in computer science or courses in other departments of the School of Science that have an appropriate mathematical content may be selected with the approval of the adviser. Normally, no more than 6 credit hours will be approved outside of mathematics and statistics.
6. The 45 credit hours of courses required above must include at least 6 credit hours from a course sequence listed below, other than MATH 441-442.

Course Sequences

Advanced calculus: MATH 510 and 525
Algebra: MATH 453, and 553 or a higher-level algebra course
Analysis: MATH 441, and 442 or a higher-level analysis course
Geometry: MATH 462, and 561 or a higher-level geometry course
Differential equations: MATH 520, and 522 or higher-level differential equations course
Modeling: MATH 426, and 517 or a higher-level modeling course
Numerical analysis: MATH 414, and 515 or a higher-level numerical analysis course
Probability and statistics: STAT 311, and 511 or a higher-level probability or statistics course
Theoretical computer science: CSCI 482 and 484

Pure Mathematics Option Sample Program (124 cr.)

Freshman Year

First Semester		Second Semester	
MATH 163 Integrated Calculus and Analytical Geometry I	5	**MATH 164** Integrated Calculus and Analytical Geometry II	5
COMM C110 Fundamentals of Speech Communication	3	**CSCI 230** Computing I	3
ENG W131 Elementary Composition I	3	Second Composition Course	3
Laboratory Science Elective	5	Science Elective	3
		Free Elective	3
	16		17

Sophomore Year

Third Semester		Fourth Semester	
MATH 261 Multivariate Calculus	4	**MATH 262** Linear Algebra and Differential Equations	4
Humanities or Social Science Elective	3	**MATH 351** Elementary Linear Algebra	3
Science Elective	3	Humanities or Social Science Elective	3
Free Electives	6	Science Elective	3
		Free Elective	3
	16		16

Junior Year

Fifth Semester		Sixth Semester	
MATH 441 Foundations of Analysis	3	**MATH 442** Foundations of Analysis II	3
MATH or **STAT** Elective	3	**MATH 510** Vector Calculus	3
Foreign Language	5	Humanities or Social Science Elective	3
Humanities or Social Science Elective	3	Free Electives	6
	14		15

Senior Year

Seventh Semester		Eighth Semester	
MATH or **STAT** Electives	6	**MATH 453** Abstract Algebra	3
Free Electives	9	**MATH** or **STAT** Elective	3
		Free Electives	9
	15		15

APPLIED MATHEMATICS OPTION

Graduates with training in applied mathematics are employed in business, industry, and government. They would probably work as part of a team and would often need to communicate mathematical ideas to persons trained in other subjects. In many instances, they would need to formulate problems for solution on a computer and then interpret the answers. Thus, besides a fundamental knowledge of mathematics, a knowledge of what computers can do is essential. This option is also a good preparation for graduate study in applied mathematics, computer science, statistics, and engineering.

The Area IV major requirements are as follows:

1. Core curriculum: MATH 163, 164, 261, 262, and 351.
2. MATH 414 Numerical Methods.
3. MATH 510 Vector Calculus.
4. Mathematical modeling: MATH 426 *or* 517.
5. 15 additional credit hours in mathematics or statistics courses at the 300 level or higher. Courses in computer science or courses in other departments of the School of Science that have an appropriate mathematical content may be selected with the approval of the adviser. Normally, no more than 6 credit hours will be approved outside of mathematics and statistics.
6. The 45 credit hours of courses required above must include at least 6 credit hours in each of two of the course sequences listed below. Students planning on attending graduate school in mathematics are advised to take MATH 441-442.

Course Sequences
Advanced calculus: MATH 510 and 525
Algebra: MATH 453, and 553 or a higher-level algebra course
Analysis: MATH 441, and 442 or a higher-level analysis course
Differential equations: MATH 520, and 522 or a higher-level differential equations course
Geometry: MATH 462, and 561 or a higher-level geometry course
Modeling: MATH 426, and 517 or a higher-level modeling course
Numerical analysis: MATH 414, and 515 or a higher-level numerical analysis course
Probability and statistics: STAT 311, and 511 or a higher-level probability or statistics course
Theoretical computer science: CSCI 482 and 484

Applied Mathematics Option Sample Program (124 cr.)

Freshman Year

First Semester		Second Semester	
MATH 163 Integrated Calculus and Analytical Geometry I	5	**MATH 164** Integrated Calculus and Analytical Geometry II	5
ENG W131 Elementary Composition I	3	**COMM C110** Fundamentals of Speech Communication	3
Humanities or Social Science Elective	3	**CSCI 230** Computing I	3
Free Electives	6	Second Composition Course	3
	17		14

Sophomore Year

Third Semester		Fourth Semester	
MATH 261 Multivariate Calculus	4	**MATH 262** Linear Algebra and Differential Equations	4
PHYS 152 Mechanics	4	**MATH 351** Elementary Linear Algebra	3
Humanities or Social Science Elective	3	**PHYS 251** Heat, Electricity, and Optics	5
Free Electives	6	Free Elective	3
	17		15

Junior Year

Fifth Semester		Sixth Semester	
MATH 414 Numerical Methods	3	**MATH** 426 Introduction to Applied Mathematics and Modeling *or* **MATH 517** Discrete Modeling and Game Theory	3
PHYS 342 Modern Physics	3	**MATH 510** Vector Calculus	3
MATH or **STAT** Elective	3	**PHYS 310** Intermediate Mechanics	4
Foreign Language	3	Humanities or Social Science Elective	3
Humanities or Social Science Elective	3	Foreign Language	3
	15		16

Senior Year

Seventh Semester		Eighth Semester	
MATH or **STAT** Electives	6	**MATH** or **STAT** Electives	6
Free Electives	9	Free Electives	9
	15		15

SECONDARY SCHOOL TEACHING OPTION

Persons who wish to teach in secondary schools must meet the requirements for teacher certification in the state in which they expect to teach. Interested persons can obtain these requirements by writing to the Department of Public Instruction, Certification Office, in the capital city of any state.

According to Indiana state law, a student should have 40 credit hours in general education courses and a specified core of professional education courses as part of the requirement for a teaching license. Students should be sure to see an adviser to ensure that these hours are properly distributed and that the professional education requirements are met. In particular,

students should be sure that their course work includes at least one biology course. The secondary teaching program here that has been approved by the state of Indiana requires the completion of at least 36 credit hours of mathematics courses.

The Area IV major requirements are as follows:
1. Core curriculum: MATH 163, 164, 261, 262, and 351.
2. MATH 300 Logic and the Foundations of Algebra.
3. MATH 453 Abstract Algebra.
4. Geometry: MATH 563[1] (or 561).
5. Probability and statistics: STAT 311 *or* 511.
6. One additional mathematics or statistics course at the 300 level or higher. Courses in computer science or courses in other departments of the School of Science that have an appropriate mathematical content may be selected with the approval of the adviser.

Secondary School Teaching Option Sample Program (124 cr.)

Freshman Year

First Semester
MATH 163 Integrated Calculus and Analytical Geometry I 5
ENG W131 Elementary Composition I 3
Humanities or Social Science Elective 3
Laboratory Science Elective 4-5
15-16

Second Semester
MATH 164 Integrated Calculus and Analytical Geometry II 5
EDUC H340 Education and American Culture 3
ENG W132 Elementary Composition II 3
PSY B104 Psychology as a Social Science *or* **PSY B105** Psychology as a Biological Science 3
Science Elective 3
17

Sophomore Year

Third Semester
MATH 261 Multivariate Calculus 4
COMM C110 Fundamentals of Speech Communication 3
CSCI 230 Computing I 3
EDUC M201 Field Experience: Educational Psychology 1
EDUC P255 Educational Psychology 3
Science Elective 3
17

Fourth Semester
MATH 262 Linear Algebra and Differential Equations 4
MATH 351 Elementary Linear Algebra 3
EDUC W200 Microcomputing for Education 1
Science Elective 3
Free Elective 3
14

Junior Year

Fifth Semester
STAT 311 Introductory Probability 3
MATH 300 Logic and the Foundations of Algebra 3
EDUC M300 Teaching in a Pluralistic Society 3
EDUC M314 General Methods for Senior High/Junior High/Middle School Teachers *and* **EDUC M301** Field Experience 3
Foreign Language 5
17

Sixth Semester
MATH 453 Abstract Algebra 3
EDUC M464 Methods of Teaching Reading 3
Humanities or Social Science Elective 3
Free Electives 6
15

Senior Year

Seventh Semester		Eighth Semester	
EDUC M457 Methods of Teaching Senior High/Junior High/Middle School Mathematics *and*		**MATH 563**[1] Advanced Geometry	3
EDUC M403 Field Experience	4	**EDUC M470** Practicum	6
MATH or **STAT** Elective	3	**EDUC M480** Student Teaching: Secondary	10
Humanities or Social Science Elective	3		19
Free Electives	6		
	16		

Minor in the Mathematical Sciences

There are many fields in which a minor in mathematics would be useful. A scientist or engineer may need a knowledge of differential equations and linear algebra, while someone in business or a social science may need a background in probability or statistics.

Requirements

1. The calculus sequence MATH 163, 164, and 261 (14 cr.).
2. Two additional courses selected from mathematics courses numbered 262 or higher or from statistics courses numbered 311 or higher.
3. 9 credit hours of the minor must be completed at IUPUI.
4. The grade in each course submitted for the minor must be C (2.0) or higher.

Correspondence courses may not be used to fulfill requirements for the minor.

Graduate Programs

The Department of Mathematical Sciences offers graduate training leading to the Purdue M.S. degree. Qualified students may be authorized to pursue the Ph.D. in mathematics at IUPUI in areas where a program has been arranged with Purdue, West Lafayette. The M.S. degree requires two years of graduate study, and the Ph.D. degree typically requires two to three additional years of study.

Admission Requirements

Students entering a graduate program in mathematics should have completed an undergraduate program containing as many courses in abstract algebra, linear algebra, advanced calculus, differential equations, logic and foundations, and probability as possible.

Students entering the graduate program in applied mathematics should have completed an undergraduate program in mathematics or an undergraduate program in engineering or physical sciences that is strongly oriented toward mathematics.

Students entering the master's program in applied statistics must have a bachelor's degree from an accredited institution. The minimal mathematics requirement for admisssion to this program includes an undergraduate sequence in univariate and multivariate calculus (equivalent to MATH 163, 164, 261) and one mathematics course beyond the calculus level. Prospective applicants who do not have this background must take all or part of the calculus sequence prior to admission to the program. Applicants who lack a course beyond the calculus sequence must complete such a course as soon as possible after conditional admission.

Application for Admission

Students who wish to pursue an advanced degree in the Department of Mathematical Sciences should fill out a graduate student application form. Applicants are urged to submit GRE scores in mathematics. Foreign students for whom English is not their native language and who have not completed a bachelor's or master's degree program from an English-speaking university must submit TOEFL scores. While this application is being processed, the student may enter IUPUI as a temporary graduate student. Not more than 12 hours of credit earned under this classification may be applied toward an advanced degree. Those who do not want to pursue an advanced degree, but desire to take graduate courses for personal improvement, may also take courses under the temporary graduate student classification.

[1]MATH 563 is offered only in the spring of even-numbered years.

Transfer Credit

The Department of Mathematical Sciences will accept by transfer a maximum of 9 hours of graduate credit, in excess of undergraduate degree requirements, from approved institutions.

Assistantships and Fellowships

Financial support is available to qualified students in the form of University Fellowships, graduate teaching assistantships, and tuition scholarships. Additional summer support is available through summer teaching for students whose performance in course work and assistantship duties is satisfactory.

English Requirements

All advanced degree candidates are required to demonstrate acceptable proficiency in English composition.

The English requirement for candidates whose native language is English is satisfied by having no undergraduate grades below B in composition or by scoring 600 or higher on the Verbal Aptitude Section of the Graduate Record Examination. Students who do not satisfy the English requirement by either of the above methods may take a written examination administered by the English department to demonstrate their proficiency.

Foreign students for whom English is not the native language and who have not completed a bachelor's or master's degree program from an English-speaking university must take the ESL exam administered by the IUPUI English as a Second Language Program. Students not scoring sufficiently high will be required to take designated courses in English while pursuing their graduate studies.

Master of Science

A minimum of 30 credit hours of course work is required for an M.S. degree. Course grades must be A or B with the possible exception of at most two grades of C. Neither a thesis nor a comprehensive examination is required. Several core courses are specific to an M.S. plan of study and vary according to the student's interest in (a) pure mathematics with a Ph.D. objective; (b) pure mathematics without a Ph.D. objective; (c) applied mathematics with a Ph.D. objective; and (d) applied mathematics without a Ph.D. objective. The remaining courses are selected by the student and his or her advisory committee.

Master of Science (Option for Teachers)

This nonthesis program requires a minimum of 33 credit hours of course work and is tailored for secondary school teachers and students who are preparing to become secondary school teachers. Required courses are MATH 519, 525, 544, 553, 554, 571, and a course in geometry selected from MATH 561, 562, and 563. Course grades must be A or B with the possible exception of at most two grades of C.

Master of Science (Concentration in Applied Statistics)

The Master of Science degree with a concentration in applied statistics consists of a minimum of 30 credit hours. Course grades must be A or B with the possible exception of at most two grades of C. Candidates for this degree may choose either the thesis option or the nonthesis option. Both options require a minimum of 15 credit hours from the core curriculum consisting of STAT 512, 514, 519, 525, 528, and 530. The three-course sequence in probability and mathematical statistics (STAT 519, 528, 530) must be taken by all degree candidates.

The nonthesis option consists of 15 credit hours beyond the core curriculum, at least 9 of which must be statistics (STAT) courses. The remaining courses may be taken in mathematics or in areas relevant to statistical applications, subject to approval of the academic adviser. A combined written and oral final examination is required.

The thesis option requires a thesis worth 6 credit hours on a topic approved by the candidate's academic adviser. At least 6 of the remaining 9 credit hours must be taken in mathematics or in a subject related to statistical applications that has been approved by the adviser. A written final examination and an oral defense of the thesis are required.

Doctor of Philosophy

Qualified students may be authorized to pursue the Ph.D. in mathematics at IUPUI in areas where a program has been arranged with Purdue, West Lafayette. To be admitted to candidacy

for the Ph.D. degree, the student must have fulfilled the following requirements and must have been accepted by some member of the staff who will supervise the student's research and who will act as chairperson of the advisory committee.

Requirements

1. The student must satisfy, by one of the five options approved by the Graduate School, the foreign language requirement in one of the following: German, Russian, and French.
2. The student must pass the qualifying examinations in analysis, in algebra, and in one area chosen from topology, applied mathematics, and numerical analysis. These are written examinations offered twice a year near the beginning of the fall and spring semesters. A student who does not pass the examinations will have the option, only once, of repeating them. Normally, a student would take the examinations after one year of graduate courses.
3. The student must submit to the Graduate School through the department a plan of study including at least 42 credit hours of approved graduate course work.
4. The student must pass advanced topics examinations. These oral or written examinations may be taken only by students who have completed requirement 2.

A candidate will be recommended to the faculty to receive the Ph.D. degree after a thesis, submitted in final form, has been accepted by the advisory committee and presented before an open colloquium or seminar.

There are time limits set by the department for completion of the Ph.D. degree.

Courses in Mathematical Sciences (MATH)

Note: Statistics courses (STAT) follow MATH listings. P—prerequisite; C—corequisite; R—recommended; Fall—offered fall semester; Spring—offered spring semester; Summer—offered in the summer session. For courses with no designated semester, consult the *Schedule of Classes*. Equiv.—course is equivalent to the indicated course taught at Indiana University Bloomington, or the indicated course taught at Purdue University, West Lafayette.

Special Service Courses

001 Remedial Algebra (3 cr.) P: Eighth-grade mathematics. Fall, Spring, Summer. Covers the material in the first year of high school algebra. Numbers and algebra, integers, rational numbers, equations, polynomials, graphs, systems of equations, inequalities, radicals. Credit does not apply toward any degree.

002 Geometry (3 cr.) This course is intended to provide one unit of geometry as a first encounter or as a review for those students with little or no geometry background and needing this prerequisite to pursue higher-level course work. The purpose of this course is to teach plane and solid geometry, right triangle trigonometry, and mathematical logic through a structure focused on problem-solving and critical thinking skills.

M010 Pre-Algebra (3 cr.) Covers the required material for preparation for algebra courses. Whole numbers, fractions, decimals, percents, square roots, measurement, and rational numbers. Credit does not apply toward any degree.

Undergraduate Level

Lower-Division Courses

111 Algebra (4 cr.) P: 001 or one year of high school algebra. Fall, Spring, Summer. Real numbers, linear equations and inequalities, systems of equations, polynomials, exponents, logarithmic functions. Covers material in the third semester of high school algebra.

M118 Finite Mathematics[1] (3 cr.) P: 111 or equivalent. Fall, Spring, Summer. Set theory, vectors, matrices, permutations, combinations, simple probability, conditional probability, linear programming, graphical and simplex methods, duality theorem.

M119 Brief Survey of Calculus I (3 cr.) P: M118 or 111 or equivalent. Fall, Spring, Summer. Sets, limits, derivatives and applications, integrals and applications, functions of several variables.

123 Elementary Concepts of Mathematics (3 cr.) P: None. Mathematics for liberal arts students; experiments and activities that provide an introduction to inductive and deductive reasoning, number sequences, functions and curves, probability, statistics, topology, metric measurement, and computers.

130 Mathematics for Elementary Teachers I[1] (3 cr.) P: 111 or equivalent; one year of high school geometry. Fall, Spring. Numeration systems, mathematical reasoning, integers, rationals, reals, properties of number systems, decimal and fractional notations, problem solving.

[1]The sequence MATH M118, 130, 132 fulfills the mathematics requirement for elementary education majors.

132 Mathematics for Elementary Teachers III[1] **(3 cr.)** P: 130. Fall, Spring. Metric and nonmetric properties of geometric figures, measurement; introduction to the foundations of Euclidean geometry; coordinate geometry.

151 Algebra and Trigonometry (5 cr.) P: 111 or three semesters of high school algebra. Fall, Spring, Summer I. 151 is a one-semester version of 153-154. Not open to students with credit in 153 or 154. 151 covers college-level algebra and trigonometry. Provides preparation for 163 and 164.

153 Algebra and Trigonometry I (3 cr.) P: 111 or three semesters of high school algebra. Fall, Spring, Summer. 153-154 is a two-semester version of 151. Not open to students with credit in 151. 153 covers college-level algebra. Provides preparation for 163 and 221.

154 Algebra and Trigonometry II (3 cr.) P: 153 or four semesters of high school algebra. Fall, Spring, Summer. 153-154 is a two-semester version of 151. Not open to students with credit in 151. 154 covers college-level trigonometry. Provides preparation for 163 and 221.

163 Integrated Calculus and Analytic Geometry I (5 cr.) P: 151 or equivalent, and one year of geometry. Equiv. IU MATH M215. Fall, Spring, Summer I. Review of plane analytic geometry and trigonometry, functions, limits, differentiation, applications of differentiation, integration, the fundamental theorem of calculus, and applications of integration.

164 Integrated Calculus and Analytic Geometry II (5 cr.) P: 163. Equiv. IU MATH M216. Fall, Spring, Summer I. Transcendental functions, techniques of integration, indeterminant forms and improper integrals, conics, polar coordinates, sequences, infinite series, and power series.

179 Computers and Mathematics (3 cr.) P: 163. Exploration of some modern mathematical concepts, using the computer as an experimental tool. Possible topics include iteration, fixed points, convergence, stability/instability, chaos, fractals. Function approximation: polynomials, splines, computer graphics. Calculus: numerical approximations, symbolic manipulations. Arithmetic with large integers: prime numbers, factorization, encryption, unsolved problems in number theory.

221 Calculus for Technology I (3 cr.) P: 151 or equivalent, and one year of geometry. Fall, Spring, Summer. Analytic geometry, the derivative and applications, the integral and applications.

222 Calculus for Technology II (3 cr.) P: 221. Fall, Spring, Summer. Differentiation of transcendental functions, methods of integration, power series, Fourier series, differential equations.

261 Multivariate Calculus (4 cr.) P: 164. Equiv. IU MATH M311. Fall, Spring, Summer. Spatial analytic geometry, vectors, curvilinear motion, curvature, partial differentiation, multiple integration, line integrals, Green's theorem.

262 Linear Algebra and Differential Equations (4 cr.) P: 164. R: 261. Fall, Spring, Summer. First-order equations, higher-order linear equations, initial and boundary value problems, power series solutions, systems of first-order equations, Laplace transforms, applications. Requisite topics of linear algebra: vector spaces, linear independence, matrices, eigenvalues, and eigenvectors.

Upper-Division Courses

300 Logic and the Foundations of Algebra (3 cr.) P: 163. Fall. Logic and the rules of reasoning, theorem proving. Applications to the study of the integers; rational, real, and complex numbers; and polynomials. Bridges the gap between elementary and advanced courses. Recommended for prospective high school teachers.

351 Elementary Linear Algebra (3 cr.) P: 261. Not open to students with credit in 511. Fall, Spring. Systems of linear equations, matrices, vector spaces, linear transformations, determinants, inner product spaces, eigenvalues, applications.

375 Theory of Interest (3 cr.) P: 261. An introduction to the theory of finance including such topics as compound interest, annuities certain, amortization schedules, sinking funds, bonds, and related securities.

414 Numerical Methods (CSCI 414) (3 cr.) P: 262 and a course in a higher-level programming language (other than BASIC). Not open to students with credit in CSCI 512. Error analysis, solution of nonlinear equations, direct and iterative methods for solving linear systems, approximation of functions, numerical differentiation and integration, numerical solution of ordinary differential equations.

426 Introduction to Applied Mathematics and Modeling (3 cr.) P: 262 and 351. Introduction to problems and methods in applied mathematics and modeling. Formulation of models for phenomena in science and engineering, their solution, and physical interpretation of results. Examples chosen from solid and fluid mechanics, mechanical

[1]The sequence MATH M118, 130, 132 fulfills the mathematics requirement for elementary education majors.

systems, diffusion phenomena, traffic flow, and biological processes.

441 Foundations of Analysis (3 cr.) P: 261. Set theory, mathematical induction, real numbers, completeness axiom, open and closed sets in $\mathbb{R}^m$, sequences, limits, continuity and uniform continuity, inverse functions, differentiation of functions of one and several variables.

442 Foundations of Analysis II (3 cr.) P: 441. Continuation of differentiation, the mean value theorem and applications, the inverse and implicit function theorems, the Riemann integral, the fundamental theorem of calculus, point-wise and uniform convergence, convergence of infinite series, series of functions.

453 Abstract Algebra (3 cr.) P: 351 or consent of the instructor. Fundamental properties of groups, rings, and fields with emphasis on structure, morphisms, quotients, and fundamental homomorphism theorems.

462 Elementary Differential Geometry (3 cr.) P: 351. Calculus and linear algebra applied to the study of curves and surfaces. Curvature and torsion, Frenet-Serret apparatus and theorem, fundamental theorem of curves. Transformation of $\mathbb{R}^2$, first and second fundamental forms of surfaces, geodesics, parallel translation, isometries, fundamental theorem of surfaces.

490 Topics in Mathematics for Undergraduates (1-5 cr.) By arrangement. Open to students only with the consent of the department. Supervised reading and reports in various fields.

S490 Senior Seminar (3 cr.)

495 TA Instruction (0 cr.) For teaching assistants. Intended to help prepare TAs to teach by giving them the opportunity to present elementary topics in a classsroom setting under the supervision of an experienced teacher who critiques the presentations.

Undergraduate and Graduate Level

510 Vector Calculus (3 cr.) P: 261. Calculus of functions of several variables and of vector fields in orthogonal coordinate systems. Optimization problems, implicit function theorem, Green's theorem, Stokes' theorem, divergence theorems, applications to engineering and the physical sciences.

511 Linear Algebra with Applications (3 cr.) P: 261. Not open to students with credit in 351. Matrices, rank and inverse of a matrix, decomposition theorems, eigenvectors, unitary and similarity transformations on matrices.

517 Discrete Modeling and Game Theory (3 cr.) P: 262, and 351 or 511 or consent of instructor. Linear programming; mathematical modeling of problems in economics, managment, urban administration, and the behavioral sciences.

519 Introduction to Probability (STAT 519) (3 cr.) P: 262. Algebra of sets, sample spaces, combinatorial problems, conditional probability, independence, random variables, distribution functions, characteristic functions, special distributions, limit theorems.

520 Boundary Value Problems of Differential Equations (3 cr.) P: 261 and 262. Sturm-Liouville theory, singular boundary conditions, orthogonal expansions, separation of variables in partial differential equations, spherical harmonics.

522 Qualitative Theory of Differential Equations (3 cr.) P: 262 and 351. Laplace transforms, systems of linear and nonlinear ordinary differential equations, brief introduction to stability theory, approximation methods, other topics.

523 Introduction to Partial Differential Equations (3 cr.) P: 262 and 510, or consent of instructor. Method of characteristics for quasilinear first-order equations; complete integral; Cauchy-Kowalewsky theory; classification of second-order equations in two variables; canonical forms; difference methods of hyperbolic and parabolic equations; Poisson integral method for elliptic equations.

525 Introduction to Complex Analysis (3 cr.) P: 261 and 262. Complex numbers and complex-valued functions; differentiation of complex functions; power series, uniform convergence; integration, contour integrals; elementary conformal mapping.

526 Principles of Mathematical Modeling (3 cr.) P: 262 and 510, or consent of instructor. Ordinary and partial differential equations of physical problems, simplification, dimensional analysis, scaling, regular and singular perturbation theory, variational formulation of physical problems, continuum mechanics, and fluid flow.

530 Functions of a Complex Variable I (3 cr.) P or C: 544. Complex numbers, holomorphic functions, harmonic functions, linear transformations. Power series, elementary functions, Riemann surfaces, contour integration, Cauchy's theorem, Taylor and Laurent series, residues. Maximum and argument principles. Special topics.

531 Functions of a Complex Variable II (3 cr.) P: 530. Compactness and convergence in the space of analytic functions, Riemann mapping theorem, Weierstrass factorization theorem, Runge's theorem, Mittag-Leffler theorem, analytic continuation and Reimann surfaces, Picard theorems.

532 Elements of Stochastic Processes (3 cr.) P: 519 and 525. A basic course in stochastic processes including normal processes, covariance processes, Poisson processes, renewal processes, and Markov processes.

535 Theoretical Mechanics (3 cr.) P: 262 and PHYS 152. Kinematics and dynamics of systems of particles and of rigid bodies; Lagrange and Hamilton-Jacobi equations; oscillations about equilibrium; Hamiltonian systems; integral invariants; transformation theory.

536 Perturbation and Asymptotic Analysis (3 cr.) P: 525 or 530, and 523. Matched asymptotic expansions, inner and outer expansions, strained coordinates and multiple scales, turning point analysis.

544 Real Analysis and Measure Theory (3 cr.) P: 441 or consent of instructor. Algebras of sets, real number system, Lebesgue measure, measurable functions, Lebesgue integration, differentiation, absolute continuity, Banach spaces, metric spaces, general measure and integration theory, Riesz representation theorem.

545 Principles of Analysis II (3 cr.) P: 544. Continues the study of measure theory begun in 544.

546 Introduction to Functional Analysis (3 cr.) P: 545. By arrangement. Banach spaces, Hahn-Banach theorem, uniform boundedness principle, closed graph theorem, open mapping theorem, weak topology, Hilbert spaces.

547 Analysis for Teachers I (3 cr.) P: 261. Set theory, logic, relations, functions, Cauchy's inequality, metric spaces, neighborhoods, Cauchy sequence.

548 Analysis for Teachers II (3 cr.) P: 547. Functions on a metric space, continuity, uniform continuity, derivative, chain rule, Reimann integral, fundamental theorem of calculus, double integrals.

549 Applied Mathematics for Secondary School Teachers (3 cr.) P: 262 and 351. Applications of mathematics to problems in the physical sciences, social sciences, and the arts. Content varies. May be repeated for credit with the consent of the instructor.

550 Algebra for Teachers I (3 cr.) P: 351. Definitions and elementary properties of groups, rings, integral domains, fields. Intended for secondary school teachers.

551 Algebra for Teachers II (3 cr.) P: 550. Polynomial rings, fields, vector spaces, matrices.

553 Introduction to Abstract Algebra (3 cr.) P: 453. Group theory: Sylow theorems, Jordan-Holder theorem, solvable groups. Ring theory: unique factorization in polynomial rings and principal ideal domains. Field theory: ruler and compass constructions, roots of unity, finite fields, Galois theory, solvability of equations by radicals.

554 Linear Algebra (3 cr.) P: 351. Review of basics: vector spaces, dimension, linear maps, matrices, determinants, linear equations. Bilinear forms; inner product spaces; spectral theory; eigenvalues. Modules over principal ideal domain; finitely generated abelian groups; Jordan and rational canonical forms for a linear transformation.

556 Introduction to the Theory of Numbers (3 cr.) P: 261. Divisibility, congruences, quadratic residues, Diophantine equations, the sequence of primes.

561 Projective Geometry (3 cr.) P: 351. Projective invariants, Desargues' theorem, cross-ratio, axiomatic foundation, duality, consistency, independence, coordinates, conics.

562 Introduction to Differential Geometry and Topology (3 cr.) P: 351 and 442. Smooth manifolds, tangent vectors, inverse and implicit function theorems, submanifolds, vector fields, integral curves, differential forms, the exterior derivative, DeRham cohomology groups, surfaces in E^3, Gaussian curvature, two-dimensional Riemannian geometry, Gauss-Bonnet and Poincaré theorems on vector fields.

563 Advanced Geometry (3 cr.) P: 300 or consent of the instructor. Analysis of axiomatic systems, finite geometries, critique of Euclid, axiomatic development, incidence, existence, betweenness, congruence, non-Euclidean geometry. Parallel postulate, Hilbert's geometry, hyperbolic geometry, models.

571 Elementary Topology (3 cr.) P: 441. Topological spaces, metric spaces, continuity, compactness, connectedness, separation axioms, nets, function spaces.

572 Introduction to Algebraic Topology (3 cr.) P: 571. Singular homology theory, Ellenberg-Steenrod axioms, simplicial and cell complexes, elementary homotopy theory, Lefschetz fixed point theorem.

581 Introduction to Logic for Teachers (3 cr.) P: 351. Not open to students with credit in 385. Logical connectives, rules of sentential inference, quantifiers, bound and free variables, rules of inference, interpretations and validity, theorems in group theory, introduction to set theory.

583 History of Elementary Mathematics (3 cr.) P: 261. A survey and treatment of the content of major developments of mathematics through the eighteenth century, with selected topics from more recent mathematics,

including non-Euclidean geometry and the axiomatic method.

585 Mathematical Logic I (CSCI 585) (3 cr.) P: 351. Formal theories for propositional and predicate calculus with study of models, completeness, compactness. Formalization of elementary number theory; Turing machines, halting problem, and the undecidability of arithmetic.

587 General Set Theory (3 cr.) P: 351. Informal axiomatization of set theory, cardinal numbers, countable sets, cardinal arithmetic, order types, well-ordered sets and ordinal numbers, axiom of choice and equivalences, paradoxes of intuitive set theory, Zermelo-Fraenkel axioms.

598 Topics in Mathematics (1-5 cr.) By arrangement. Directed study and reports for students who wish to undertake individual reading and study on approved topics.

Graduate Level

611 Methods of Applied Mathematics I (3 cr.) Introduction to Banach and Hilbert spaces, linear integral equations with Hilbert-Schmidt kernels, eigenfunction expansions, and Fourier transforms.

612 Methods of Applied Mathematics II (3 cr.) P: 611. Continuation of theory of linear integral equations; Sturm-Liouville and Weyl theory for second-order differential operators, distributions in n dimensions, and Fourier transforms.

626 Mathematical Formulation of Physical Problems I (3 cr.) P: Graduate standing and consent of instructor. Topics to be chosen from the following: Tensor formulation of the field equations in continuum mechanics, fluid dynamics, hydrodynamic stability, wave propagation, and theoretical mechanics.

627 Mathematical Formulation of Physical Problems II (3 cr.) P: 626. Continuation of 626.

642 Methods of Linear and Nonlinear Partial Differential Equations (3 cr.) P: 520, 523, and 611. Topics from linear and nonlinear partial differential equations, varied from time to time.

646 Functional Analysis (3 cr.) P: 546. Advanced topics in functional analysis, varying from year to year at the discretion of the instructor.

672 Algebraic Topology I (3 cr.) P: 572. A continuation of 572; cohomology, homotopy groups, fibrations, further topics.

673 Algebraic Topology II (3 cr.) P: 672. A sequel to 672 covering further advanced topics in algebraic and differential topology such as K-theory and characteristic classes.

692 Topics in Applied Mathematics (1-3 cr.)

693 Topics in Analysis (1-3 cr.)

694 Topics in Differential Equations (1-3 cr.)

697 Topics in Topology (1-3 cr.)

699 Research Ph.D. Thesis (cr. arr.)

Courses in Statistics (STAT)

Undergraduate Level

Upper-Division Courses

301 Elementary Statistical Methods I (3 cr.) P: MATH 111 or equivalent. Not open to students in the Department of Mathematical Sciences. Fall, Spring. A basic introductory statistics course with applications shown to various fields and emphasis placed on assumptions, applicability, and interpretations of various statistical techniques. Subject matter includes frequency distribution, descriptive statistics, elementary probability, normal distribution, applications, sampling distribution, estimation, hypothesis testing, and linear regression.

302 Elementary Statistical Methods II (3 cr.) P: 301 or equivalent. Continuation of 301. Multiple regression and analysis of variance, with emphasis on statistical inference and applications to various fields.

311 Introductory Probability (3 cr.) P: MATH 261 or equivalent. Fall. Fundamental axioms and laws of probability; finite sample spaces and combinatorial probability; conditional probability; Bayes theorem; independence; discrete and continuous random variables; univariate and bivariate distributions; binomial, negative binomial, Poisson, normal, and gamma probability models; mathematical expectation; moments and moment generating functions.

490 Topics in Statistics for Undergraduates (1-5 cr.) Supervised reading and reports in various fields.

Undergraduate and Graduate Level

511 Statistical Methods I (3 cr.) P: MATH 164. Fall, Spring. Descriptive statistics; elementary probability; normal, binomial, Poisson, and hypergeometric distributions; sampling distributions; testing hypotheses and estimation; one-way analysis of variance; chi-square test; correlation and regression.

512 Applied Regression Analysis (3 cr.) P: 511. Linear and multiple regression; nonlinear regression; analysis of variance; random, fixed, mixed models; nested factorial; expected mean squares; pooling; modifications under relaxed assumptions; multiple comparisons; variance of estimates; analysis of covariance.

513 Statistical Quality Control (3 cr.) P: 511. Control charts and acceptance sampling, continuous sampling plans, sequential analysis, statistics of combinations, and some nonparametric methods.

514 Design of Experiments (3 cr.) P: 512. Fundamentals, completely randomized design, randomized complete blocks; Latin square; multiclassification; factorial; incomplete blocks and fractional replications; confounding; lattice design; general mixed factorials; split plot; optimum design.

515 Statistical Consulting Problems (1-3 cr.) P: consent of instructor. Consultation on a problem involving statistical analysis in participation with a faculty member. A detailed written report is required.

516 Basic Probability and Applications (3 cr.) P: MATH 262 or equivalent. A first course in probability intended to serve as a foundation for statistics and other applications. Intuitive background; sample spaces and random variables; joint, conditional, and marginal distributions; special distributions of statistical importance; moments and moment generating functions; statement and application of limit theorems; Markov chains.

517 Statistical Inference (3 cr.) P: 516 or MATH 519. An introduction to the mathematical theory of statistical inference. Topics include sampling distributions, order statistics and their applications, point and interval estimation emphasizing the maximum likelihood method, the Neyman-Pearson Lemma, likelihood ratio tests, introduction to the normal linear model.

519 Introduction to Probability (MATH 519) (3 cr.) P: MATH 510 or MATH 441. Algebra of sets, sample spaces, combinatorial problems, conditional probability, independence, random variables, distribution functions, moment generating functions, special distributions, limit theorems.

520 Time Series and Applications (3 cr.) P: 519. A first course in stationary time series with applications to engineering, economics, and physical sciences. AR, MA, ARMA, ARIMA models. Stationarity, autocovariance function, integral represention of stationary time series and interpretation, linear filtering, transfer functions, spectral estimation, multivariate time series, computer applications.

522 Sampling and Survey Techniques (3 cr.) P: 512 or equivalent. Survey designs; simple random, stratified, and systematic samples; sampling systems; methods of estimation; cost analysis.

523 Categorical Data Analysis (3 cr.) P: 512 or equivalent. Models generating binary and categorical response data, two-way classification tables, measures of association and agreement, goodness-of-fit test, testing for independence, large sample properties, general linear model, logistic regression, probit and extreme value models, loglinear models, maximum likelihood estimation, partitioning chi-squares, model-building and selection procedures, models for ordinal data, computer applications using SAS.

524 Applied Multivariate Analysis (3 cr.) P: 512 or equivalent. Extension of univariate test for normal populations to the multivariate case, equality of covariance matrices, multivariate analysis of variance, discriminant analysis and misclassification errors, canonical correlation, principle components, factor analysis, emphasis on computer applications.

525 Intermediate Statistical Methodology (3 cr.) P: 512 or equivalent. Generalized linear models, likelihood methods for data analysis, use of computer packages. Applications to multiple regression and analysis of variance. Categorical data analysis including loglinear models, contingency tables, and logistic response models.

528 Mathematical Statistics I (3 cr.) P: 519 or MATH 519. Distribution of functions of several random variables, sampling distributions, chi-square, Student-t and F distributions, convergence and limit theorems, sufficient statistics, exponential family of distributions, maximum likelihood and other methods of point estimation, confidence sets, Cramer-Rao inequality, Rao-Blackwell theorm, hypothesis testing, Neyman-Pearson theorem, UMP tests, likelihood ratio tests.

529 Bayesian Statistics and Applied Decision Theory (3 cr.) P: A course in statistics. C: 528. Bayesian and decision theoretic formulation of problems, utility functions and quantification of prior information, Bayesian decisions and inferences with applications, emperical Bayes, combination of evidence, Bayesian design and sequential analysis, comparison of statistical paradigms.

530 Mathematical Statistics II (3 cr.) P: 528. Multivariate normal distribution, quadratic forms, normal linear model with applications to regression and analysis of variance, asymptotic distribution of maximum likelihood estimators and likelihood ratio tests, distribution of order statistics with applications, rank tests, and/or other topics as time permits.

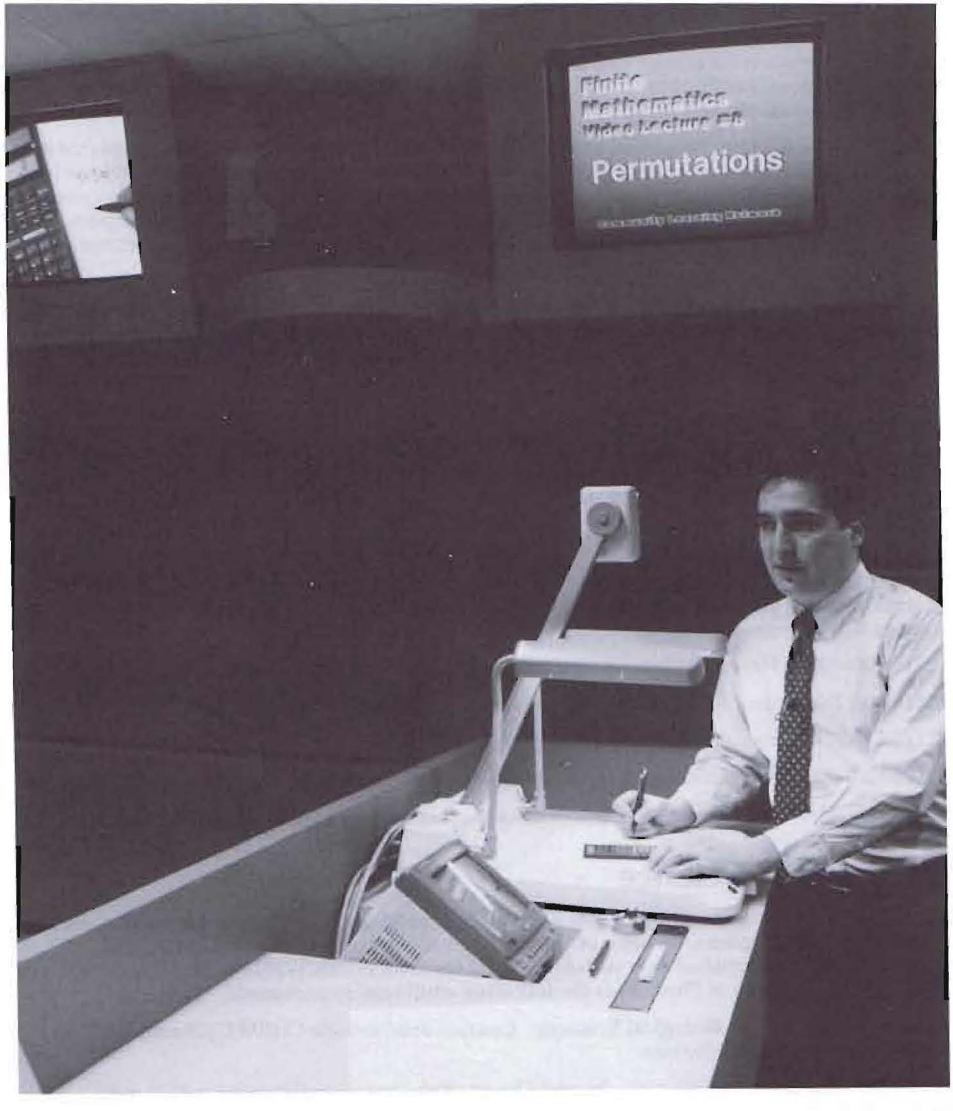
532 Elements of Stochastic Processes (3 cr.) See MATH 532.

533 Nonparametric Statistics (3 cr.) P: 512 or equivalent. Binomial test for dichotomous data, confidence intervals for proportions, one-

sample signed Wilcoxon rank test, two-sample Wilcoxon test, two-sample rank tests for dispersion, Kruskal-Wallis test for a one-way layout, Friedman rank test for a two-way layout. Kendall test for independence, one and two sample Kolmogorov-Smirnov tests, nonparametric regression.

598 Topics in Statistical Methods (1-3 cr.) P: consent of instructor. Directed study and reports for students who wish to undertake individual reading and study on approved topics.

698 Research M.S. Thesis (6 cr.) P: consent of adviser. M.S. thesis in applied statistics.



Department of Physics

Professors Kaplan, Meiere, Pearlstein, Rao (*Chairperson*), Vasavada

Associate Professors Kemple, Kleinhans, Novak, Paik, Seubert, Thatcher, Wassall

Assistant Professors Ou, Vemuri

Departmental Academic Advisers Meiere, Seubert

Physics is the study of matter and energy, from the smallest scale, as in the study of elementary particles, to the largest, as in the study of the formation and evolution of stars and galaxies. In this sense, physics is the science that underlies all of the other sciences. In principle, as well as in practice, physics is involved in virtually all scientific and technical endeavors (e.g., biophysics, geophysics, health physics, etc.)

Physicists tend to view themselves primarily as solvers of problems, especially problems that can be expressed in mathematical terms. Physics students are trained to solve complex problems by learning to analyze complex relations in mathematical terms, often with the help of today's fast computers. Because of this broadly based and flexible problem-solving background, physics graduates find employment in a variety of fields, many of which are not directly associated with physics.

The Department of Physics offers a program leading to a Bachelor of Science degree. In addition, the department provides service courses in physics and astronomy. The department also offers graduate courses that lead to the Master of Science degree. Qualified students may be authorized to pursue the Ph.D. degree in physics at IUPUI in areas where a program has been arranged with Purdue, West Lafayette.

Members of the department conduct research in several disciplines of physics and participate in joint projects with a number of other research groups, such as the Indianapolis Center for Advanced Research or the IU School of Medicine. Student participation in these projects is welcomed and encouraged.

Guide to Service Courses

Each student should consult an adviser in the department in which a degree is sought to determine which service course is appropriate. A general guide to the schools served by these courses is as follows:

PHYS 100: Allied Health, Business, and Liberal Arts (a traditional survey course)

PHYS 200: Education, SPEA, and Liberal Arts (a nontraditional course)

PHYS 218-219: A noncalculus sequence for technology students

PHYS P201-P202: A noncalculus sequence designed for preprofessional students

PHYS 152-251-342: Science and Engineering (for students requiring a calculus-based sequence)

Bachelor of Science

Areas I, II, III Minimum requirements for the School of Science are given in this bulletin under "Undergraduate Programs, Bachelor of Science Degree." The second semester of English composition may be satisfied only with ENG W132 (or ENG W150), W231, W250, W290, W331, or W350. The Department of Physics has the following additional requirements:

Area IIIC Physical and Biological Sciences Courses must include CHEM C105 and C106 with lab or their approved equivalent.

Area IIID Mathematical Sciences 24 credit hours of courses in mathematics, which must include MATH 163, 164, 261, and 262 or equivalent, plus 6 more credit hours approved by the Department of Physics. The computer science requirement of the School of Science may be satisfied with CSCI 220, CSCI 230, or any higher-level CSCI course.

Area IV Physics Concentration A concentration program in physics must include PHYS 152, 251, 300, 310, 330, 342, 342L, 353, 400, 401, 416, 442, and 490.

Courses taken outside the Schools of Science and Liberal Arts must receive departmental approval. No more than 6 credit hours of clinical, athletic, or performing arts courses will be approved. See the departmental adviser for details.

The Department of Physics recommends the following program leading to the degree of Bachelor of Science.

For the secondary school teaching option the Department of Physics may substitute other science courses for the 400-level courses and recommend education courses in order to meet teacher certification requirements.

Electives should be chosen to satisfy the general requirements for a Bachelor of Science degree from Purdue University. They also may be chosen to satisfy requirements for certification as a high school teacher.

Bachelor of Science (124 cr.)

Freshman Year

First Semester		Second Semester	
CHEM 105 Principles of Chemistry I	5	PHYS 152 Mechanics	4
ENG W131 Elementary Composition I	3	CHEM 106 Principles of Chemistry II	5
MATH 163 Integrated Calculus and Analytic Geometry I	5	MATH 164 Integrated Calculus and Analytic Geometry II	5
Social and Behavioral Sciences Elective	3	Second Composition Course	3
	16		17

Sophomore Year

Third Semester		Fourth Semester	
PHYS 251 Heat, Electricity, and Optics	5	PHYS 300 Introduction to Elementary Mathematical Physics	3
MATH 261 Multivariate Calculus	4	PHYS 342 Modern Physics	3
Arts and Humanities Elective	3	PHYS 342L Modern Physics Laboratory	1
Computer Science Elective	3	COMM C110 Fundamentals of Speech Communication	3
	15	MATH 262 Linear Algebra and Differential Equations	4
		Social and Behavioral Sciences Elective	3
			17

Junior Year

Fifth Semester		Sixth Semester	
PHYS 310 Intermediate Mechanics	4	PHYS 330 Intermediate Electricity and Magnetism	3
Arts and Humanities Elective	3	PHYS 353 Electronics Laboratory	2
Electives	8	Electives	9
	15		14

Senior Year

Seventh Semester		Eighth Semester	
PHYS 400 Physical Optics	3	PHYS 416 Thermal Physics	3
PHYS 401 Physical Optics Laboratory	2	PHYS 490 Undergraduate Reading and Research	1-3
PHYS 442 Quantum Mechanics	3	Electives	9-11
Electives	7		
	15		15

Minor in Physics

A minor in physics is available. Consult with the department for details about course requirements.

Graduate Programs

The Department of Physics offers graduate programs leading to the Master of Science and Doctor of Philosophy degrees. Course work is normally offered on the IUPUI evening schedule. The

program is designed to meet the needs of part-time students employed in the Indianapolis area, as well as traditional students who are preparing for a career in research-directed areas. For master's degree students, both a thesis and a nonthesis option are available.

Admission Requirements

The student who seeks to enroll in the physics graduate program should have a baccalaureate degree from an accredited institution and have a background in the usual undergraduate courses in physics, mathematics, and other sciences. A grade point average of 3.0 (B) or better in physics courses is expected. Graduates from related fields of study in pure and applied science or engineering may be accepted on a probationary basis until they have completed any necessary undergraduate courses in physics. The Graduate Record Examination (GRE) is normally expected of all applicants. The GRE physics test is recommended but not required.

Transfer Credit

The Department of Physics will normally accept, from approved institutions, a maximum of 6 transfer hours of graduate credit that are in excess of undergraduate degree requirements.

Application for Admission

Application materials and information can be obtained from the chairperson of the graduate committee; Department of Physics; Science, Engineering, and Technology III; 402 N. Blackford Street; IUPUI; Indianapolis, IN 46202-3273 [(317) 274-6900]. While the application is being processed, it is possible to enter IUPUI as a temporary graduate student. Generally only 12 hours of credit earned under this classification may be counted toward an advanced degree.

Financial Assistance

Most physics students receive financial support. Types of support available include teaching and research assistantships, fellowships, and tuition remission.

Master of Science

The general requirements include admission to regular graduate status, completion of the English requirement, a passing score on the Physics Qualifying Examination, satisfactory completion of an approved plan of study, and 30 hours of graduate credit as outlined below.

The English requirement for candidates whose native language is English is satisfied by having no undergraduate grades below B in English composition or by scoring 600 or higher on the Verbal Aptitude Section of the Graduate Record Examination. Students who do not satisfy the English requirement by either of the above methods may take a written examination administered by the Department of English to demonstrate their proficiency. Students whose native language is not English may meet the English requirement with a TOEFL score of 550 or better. Others are required to take a diagnostic test during their first semester at IUPUI. The score on this test will determine what English courses are required.

The Physics Qualifying Examination is administered throughout the Purdue graduate system and must be taken, at the latest, after completing the introductory graduate courses. Two attempts are permitted to obtain a passing grade.

The student's plan of study is worked out in cooperation with the student's graduate adviser and committee. It must be submitted and accepted by the Graduate School no later than the semester before the one in which the student plans to graduate. The English requirement must be satisfied before the plan of study may be filed.

The master's degree requires the satisfactory completion of 30 credit hours of course work at the 500 and 600 level. Twenty-four credit hours must be in physics and biophysics, including one laboratory course. In the thesis option, 6 of the physics credit hours will be earned by enrolling in PHYS 698 Research M.S. Thesis. This option requires a written thesis. In the nonthesis option, 6 of the physics credit hours will typically be earned through enrollment in PHYS 590 Reading and Research. This option requires a written report. Six credit hours must be in mathematics, which may be replaced in part by PHYS 600 Methods of Theoretical Physics. The grade requirements are A or B in 500-level courses; A, B, or C in 600-level courses; A, B, or C in mathematics courses; and a minimum grade point average of 2.8.

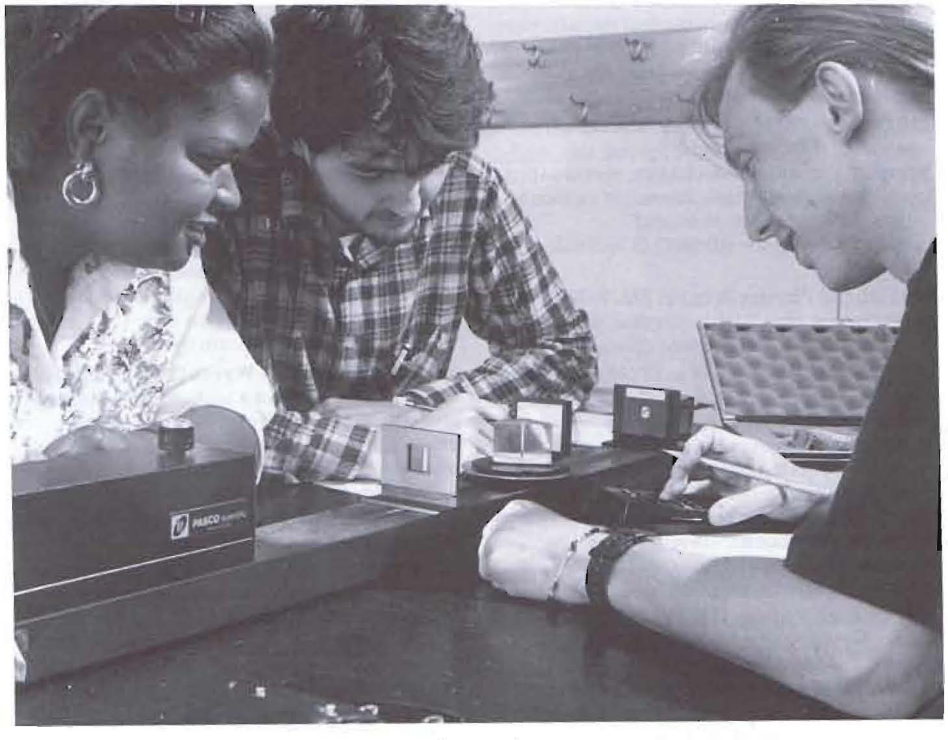
Doctor of Philosophy

Qualified students may be authorized to pursue the Ph.D. degree at IUPUI in areas where a program has been arranged with Purdue, West Lafayette. Students are usually expected to

complete an M.S. degree before pursuing the Ph.D. degree. Interested students should contact the Department of Physics for further details.

Research Interests and Facilities

The department's major research strengths and facilities are in the area of biological physics and magnetic resonance. There are four magnetic resonance spectrometers in two locations under the direction of physics faculty. In addition, there is a high performance absorption spectrometer equipped to examine cryogenic samples, as well as other instrumentation for biophysical research. Current experimental research includes EPR and NMR investigations of cells, enzymes, proteins, and model membranes. Theoretical work involves calculations and computer simulations of magnetic resonance lineshapes, studies of the biophysics of photosyntheses, and theoretical condensed matter physics. Theorists have access to the IUPUI computing facilities, which include VAX 8800 and IBM 3090 systems, as well as the minicomputers in the department. Several of these projects involve collaborations with the IU School of Medicine, Methodist Hospital of Indiana, and other departments in the School of Science.



Students studying the property of light in an optics experiment.

Courses in Physics (PHYS)

The courses in this section are not listed in strict numerical order; courses are grouped according to levels of difficulty.

Note: P—prerequisite; C—corequisite; Fall—offered fall semester; Spring—offered spring semester; Summer—offered in the summer session; Day—offered as a daytime section; Night—offered as an evening section; Equiv.—course is equivalent to the indicated course taught at Indiana University Bloomington, or the indicated course taught at Purdue University, West Lafayette.

100 Physics in the Modern World (5 cr.) P: Introductory high school mathematics. Fall, day, night; Spring, day, night; Summer, day, night. Ideas, language, methods, and impact of physics today.

200 Our Physical Environment (3 cr.) P: None. Fall, Spring. A nonmathematical introduction to physical concepts and methods by means of examples from daily life and current technological applications.

218 General Physics (4 cr.) P: MATH 151 or equivalent. Fall, day, night; Spring, day, night; Summer, day, night. Mechanics, conservation laws, gravitation; simple harmonic motion and waves; kinetic theory, heat, and thermodynamics for students in technology fields.

219 General Physics (4 cr.) P: 218. Fall, day, night; Spring, day, night; Summer, day, night. Electricity, light, and modern physics.

P201 General Physics I (5 cr.) P: MATH 151 or equivalent. Fall, Spring, Summer. Newtonian mechanics, wave motion, heat, and thermodynamics. Application of physical principles to related scientific disciplines, especially life sciences. Intended for students preparing for careers in the life sciences and the health professions. Three lectures, one discussion section, and one two-hour laboratory period each week.

P202 General Physics II (5 cr.) P: 201. Fall, Spring, Summer. Electricity and magnetism; geometrical and physical optics; introduction to concepts of relativity, quantum theory, atomic and nuclear physics. Three lectures, one discussion section, and one two-hour laboratory period each week.

152 Mechanics (4 cr.) P or C: MATH 164. Equiv. IU PHYS P221. Fall, day, night; Spring, day, night; Summer, day, night. Statics, uniform and accelerated motion; Newton's laws; circular motion; energy, momentum, and conservation principles; dynamics of rotation; gravitation and planetary motion; properties of matter; simple harmonic and wave motion.

251 Heat, Electricity, and Optics (5 cr.) P: 152. Equiv. IU PHYS P222. Fall, day, night; Spring, day, night. Heat, kinetic theory, elementary thermodynamics, heat transfer. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Geometrical and physical optics.

300 Introduction to Elementary Mathematical Physics (3 cr.) P: 251. Spring. Brief but practical introduction to various mathematical methods used in intermediate-level physics courses. Vector analysis, orthogonal coordinate systems, matrices, Fourier methods, complex numbers, special functions, and computational methods. Emphasis will be on worked examples and the application of these methods to physics problems.

310 Intermediate Mechanics (4 cr.) P: 300 and MATH 261. Fall. For students familiar with calculus. Elements of vector algebra; statics of particles and rigid bodies; theory of couples; principle of virtual work; kinematics; dynamics of particles and rigid bodies; work, power, and energy; elements of hydromechanics and elasticity.

322 Oscillations and Waves (3 cr.) P: 251. Fall. Modes of vibration of a system; emission and absorption of waves; properties of sound, electromagnetic, and particle waves including phenomena of refraction, reflection, dispersion, diffraction, interference, polarization, and double refraction; lasers and holography.

330 Intermediate Electricity and Magnetism (3 cr.) P: 251. P or C: 300 and MATH 262. Spring. Electrostatics; electric currents; magnetostatics; electromagnetic induction; Maxwell's equations; electromagnetic waves.

342 Modern Physics (3 cr.) P: 251. Equiv. IU PHYS P301. Spring. A survey of basic concepts and phenomena in atomic, nuclear, and solid state physics.

342L Modern Physics Laboratory (1 cr.) Laboratory experiments to accompany 342.

350 Intermediate Laboratory I (2 cr.) P or C: 322. (The prerequisite is waived for students enrolled in the science education degree program.) Fall. Lectures on geometrical optics; instructor demonstrations and student experiments involving mechanical and electromagnetic wave and oscillation phenomena.

351 Intermediate Laboratory II (2 cr.) P or C: 330. (The prerequisite is waived for students enrolled in the science education degree

program.) Spring. Lectures on AC circuit theory; instructor demonstrations and student experiments involving particle diffraction, wave polarization, double refraction, AC circuits, and meters.

353 Electronics Laboratory (2 cr.) P: 251. Spring. Introduction to electronic circuits and test equipment for scientists. Circuits including LRC networks, diodes, transistors, amplifiers, and digital components will be constructed and measured using oscilloscopes, function generators, and digital multimeters. Results will be analyzed in terms of basic circuit properties such as impedance and frequency response.

400 Physical Optics (3 cr.) P: 330. Fall. Electromagnetic waves; wave theory of reflection, refraction, diffraction, and interference. Spatial and temporal coherence. Fourier optics, coherent imaging, and holography. Polarization phenomena; Jones vectors and matrices.

401 Physical Optics Laboratory (2 cr.) P: 330. C: 400 (majors). Experiments to accompany PHYS 400 in reflection, refraction, and interference using lasers. Interferometry. Diffraction patterns with emphasis on Fourier analysis and Fourier transformations. Polarization, Brewster's angle. Coherence length of lasers.

416 Thermal Physics (3 cr.) P: 310 and 330. Spring. Temperature, equations of state, first and second laws of thermodynamics, entropy and applications, kinetic theory, transport processes, statistical mechanics.

442 Quantum Mechanics (3 cr.) P: 342 and either 310 or 330. Fall. Inadequacies of classical physics; wave packets and Schrödinger equation, one-dimensional problems; operator formulation of quantum mechanics; linear harmonic oscillator; angular momentum; hydrogen atom; Pauli principle and application to helium atom.

470 Reading in Special Topics (1-3 cr.)

480 Solar Energy Usage (3 cr.) P: MATH 164 or equivalent, and two terms of general physics. Theoretical and practical aspects including collector design, modeling of solar systems, economic evaluation of solar alternatives, and photovoltaics.

490 Undergraduate Reading and Research (1-3 cr.) Independent study for undergraduates.

501 Physical Science (3 cr.) P: None. Fall, Spring. Survey of the physical sciences with emphasis on methods of presentation appropriate to the elementary school. Graduate credit is extended only for elementary school teacher programs.

510 Physical Mechanics (3 cr.) P: 310 or equivalent, and courses in calculus and differential equations. Mechanics of particles, rigid bodies, and vibrating systems.

515 Thermodynamics (3 cr.) P: 310 and 330 and a course in differential equations or advanced calculus. Fall. Fundamental concepts of heat; theory and practice of heat measurements; first and second laws of thermodynamics, with applications; kinetic theory.

517 Statistical Physics (3 cr.) P: 342, 510, and 515 or equivalent. Fall, Spring. Laws of thermodynamics; Boltzmann and quantum statistical distributions, with applications to properties of gases, specific heats of solids, paramagnetism, black-body radiation, and Bose-Einstein condensation; Boltzmann transport equation and transport properties of gases; Brownian motion and fluctuation phenomena.

520 Mathematical Physics (3 cr.) P: 310, 322, 330, or consent of instructor. Vectors and vector operators, tensors, infinite series, analytic functions and the calculus of residues, partial differential equations, special functions of mathematical physics. When interests and preparation of students permit, calculus of variations and/or group theory are covered.

530 Electricity and Magnetism (3 cr.) P: 330 or equivalent. Electrostatic problems; theory of dielectrics; theory of electric conduction; electromagnetic effects due to steady and changing currents; magnetic properties of matter; Maxwell's equations; electromagnetic radiation.

545 Solid State Physics (3 cr.) P: Any undergraduate course in modern physics. Spring. Crystal structure; lattice vibrations; free electron theory of solids; band theory of solids; semiconductors; superconductivity; magnetism; magnetic resonance.

550 Introduction to Quantum Mechanics (3 cr.) P: 342 and at least one other junior-level course in each of mathematics and physics or equivalent. Fall. Brief historical survey; waves in classical physics; wavepackets; uncertainty principle; operators and wave functions; Schrodinger equation and application to one-dimensional problems; the hydrogen atom; electron spin; multielectron atoms; periodic table; molecules; periodic potentials; Bloch wave functions.

556 Introductory Nuclear Physics (3 cr.) P: 550 or equivalent. Spring. Theory of relativity; brief survey of systematics of nuclei and elementary particles; structure of stable nuclei; radioactivity; interaction of nuclear radiation with matter; nuclear reactions; particle

accelerators; nuclear instruments; fission; nuclear reactors.

570 Selected Topics in Physics (3 cr.) Specialized topics in physics selected from time to time.

590 Reading and Research (1-3 cr.)

593 Advanced Physics Laboratory (3 cr.)

600 Methods of Theoretical Physics (3 cr.) P: Graduate standing in physics or consent of instructor. 600 is designed to provide first-year physics graduate students with the mathematical background for subsequent studies of advanced mechanics, electrodynamics, and quantum theory. Topics treated include functions of a complex variable, ordinary and partial differential equations, eigenvalue problems, and orthogonal functions. Green's functions, matrix theory, and tensor analysis in three and four dimensions.

610 Advanced Theoretical Mechanics (3 cr.) P: 510 or equivalent. Fall, Spring. Lagrangian and Hamiltonian mechanics; variational principles; canonical transformations; Hamilton-Jacobi theory; theory of small oscillations; Lagrangian formulation for continuous systems and field.

630 Advanced Theory of Electricity and Magnetism (3 cr.) P: 530 and 600, or equivalent. Fall, Spring. The experimental origins of Maxwell's equations. Electrostatics and magnetostatics; solution of boundary value problems. Quasi-static currents. Electromagnetic energy and momentum and the Maxwell stress tensor. Foundations of optics. Radiation from antennas, multipole expansion; waveguides.

631 Advanced Theory of Electricity and Magnetism (3 cr.) P: 630 or equivalent. Fall, Spring. Covariant formulation of electrodynamics; Lienard-Wiechert potentials; radiation from accelerated particles; Cerenkov radiation; dynamics of relativistic particles; radiation damping; introduction to magnetohydrodynamics.

660 Quantum Mechanics I (3 cr.) P: 530, 550, 600, and 610, or equivalent. Fall, Spring. Origins of the quantum theory, the uncertainty and complementarity principles. The Schrodinger equation and its solutions for simple physical systems. Mathematical formulation of the quantum theory. Applications: simple harmonic oscillator, theory of angular momentum, hydrogen atom. Time-independent and time-dependent perturbation theory. The Pauli exclusion principle. Spin of the electron. Elementary theory of scattering.

698 Research M.S. Thesis (cr. arr.)

Courses in Astronomy (AST)

The Department of Physics has academic, advising, and administrative responsibility for the courses in astronomy offered at IUPUI.

A100 The Solar System (3 cr.) P: None. Fall. Survey of the solar system, including the earth, sun, moon, eclipses, planets and their satellites, comets, laws of planetary motion, etc. Discussion of the origin of the solar system, life on earth, and the possibilities of extraterrestrial life. Also astronomical instruments and celestial coordinates.

A105 Stellar Astronomy (3 cr.) P: None. Spring. Survey of the universe beyond the solar system, including stars, pulsars, black holes, principles of spectroscopy and the H-R diagram, nebulae, the Milky Way, other galaxies, quasars, expanding universe, cosmology, and extraterrestrial life.

Department of Psychology

Professors Bond, Davis, Tzeng

Professors Emeriti Morris, Neel, Hanford

Associate Professors Bringle, Evenbeck, Fetterman, Goldberg, Goodlett, Hazer, Kremer *(Chairperson)*, Lauer, Murphy, Rajecki, Rasmussen, Rytting (IUPUI Columbus), Shermis, Svanum, Ware

Associate Professors Emeriti Fleener, Fortier

Assistant Professors Borden, Glueckauf, Guare, Highhouse, June, Kleiner, McGrew

Adjunct Professors Alexy, McBride, Metzner, Trexler, Wagner

Psychology is the study of behavior and, as such, psychologists apply the scientific method to gain increasing understanding of human and animal behavior. Behavior is enormously diverse, and psychologists seek answers to a range of questions that are as varied as how eyes perceive light, how children develop a sense of morality, or under what conditions people help in emergencies. As an applied profession, psychologists use the results of their research to solve personal and social problems.

Because the subject matter of psychology is broad, psychologists have become specialized. Specialization allows each psychologist to apply the general principles of science and behavior to some given area of interest. These include motivation and learning, child development, social behavior of humans and animals, personality, thought processes, consumer behavior, and many more. Psychologists who function as applied professionals have specialized in areas that include clinical, counseling, health care, rehabilitation, and industrial psychology.

The IUPUI Department of Psychology provides a varied undergraduate curriculum that leads to either the Bachelor of Arts or the Bachelor of Science degree in psychology. Graduate programs include a Master of Science degree in two specialty areas of psychology—industrial/organizational and clinical rehabilitation—and a Doctor of Philosophy degree in clinical rehabilitation psychology. Besides this professional and preprofessional training, the department serves the needs of students in many other fields by providing introductory and advanced courses in psychology.

The choice of a particular program for majors should be made in consultation with one of the academic advisers. The department strongly recommends that undergraduate students become involved with the psychology club or honorary society and include an independent research experience (PSY B292 and B492) in their curricula.

Bachelor of Arts

Degree Requirements

The School of Science requirements for a Bachelor of Arts degree are listed in this bulletin under "Undergraduate Programs, Bachelor of Arts Degree."

Area I See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree" in this bulletin. The second semester of English composition may be satisfied with ENG W132 (or ENG W150), ENG W231, or ENG W290.

Area II There is no foreign language requirement.

Area III See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree" in this bulletin. The computer requirement may be satisfied with any computer science course (CSCI 207 is recommended).

Area IV See the following section, "Major in Psychology (B.A. or B.S.)."

Bachelor of Science

Degree Requirements

The School of Science requirements for a Bachelor of Science degree are listed in this bulletin under "Undergraduate Programs, Bachelor of Science Degree."

Area I See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree" in this bulletin. The second semester of English composition may be satisfied with ENG W132 (or ENG W150), ENG W231, or ENG W290.

Area II There is no foreign language requirement.

Area III See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree" in this bulletin. For Area IIIC, physical and biological sciences, two of the required four courses must be biology and/or chemistry courses. Recommended course sequences are CHEM C101-C102, or CHEM C105-C106, or BIOL N212-N213 and N214-N215. The computer requirement may be satisfied with any computer science course (CSCI 207 is recommended).

Area IV See the following section, "Major in Psychology (B.A. or B.S.)."

Major in Psychology (B.A. or B.S.)

The Department of Psychology at IUPUI has a program for majors that requires 33 credit hours of selected course work. The same requirements, which are as follows, apply to both B.A. and B.S. majors.

Introductory Psychology	**Research Methods**	**Core Areas**
(2 courses; 6 cr.)	(3 courses; 9 cr.)	(6 courses; 18 cr.)
B104	B211	6 courses from:
B105	B305	B307 B344
	1 lab from:	B310 B356
	B423 B457	B320 B370
	B425 B461	B334 B380
	B431 B471	B340 B424
	B445 B499	

Counseling Suggestions

The Department of Psychology offers counseling suggestions for students interested in completing course work that will help prepare them for graduate school or appropriate employment after graduation. These programs are known informally as the Graduate School Option, the Psychological Services Option, and the Personnel-Industrial Option. Each of these options is outlined below.

The Graduate School Option (36 credit hours) is designed to help students acquire an appropriate background, particularly in research areas, prior to applying to graduate programs. The Psychological Services Option (39 credit hours) is designed to help students acquire an appropriate background in dealing with human and social problems. The Personnel-Industrial Option (42 credit hours) is designed to help students acquire an appropriate background for a variety of business settings. However, it should be noted that the department cannot guarantee entrance to graduate school or guarantee employment, and that these options are not recognized officially on diplomas.

Successful completion of any of the three options will satisfy the Area IV requirements for psychology majors. In addition to the 6 credit hours of PSY B104-B105 Introductory Psychology, the courses that are recommended for each option are listed in the table that follows.

Option	Research Methods	Core Areas	Other
Graduate School (36 cr.)	B211 B305 Any lab	Any six courses from those listed in "Major in Psychology, Core Areas"	B492 Readings and Research or B499 Honors Research
Psychological Services (39 cr.)	B211 B305 1 lab from: B425 B461 B471	B307 B310 B370 B380 B424 1 course from: B320 B334 B344 B356	1 practicum: B472 1 course from: B364 B376 B460 or relevant 500-level psychology courses
Personnel-Industrial (42 cr.)	B211 B305 1 lab from: B425 B445 B457 B471	B307 B344 B356 B370 B424 1 course from: B310 B320 B334 B380	B366 B368 B372

Minor in Psychology

The Department of Psychology offers a minor program in psychology that requires 18 credit hours of selected course work. Interested students should obtain information from and submit an application to the psychology secretary. Applications must be approved by the Department of Psychology. Course requirements are as follows.

Introductory Psychology	**Core Areas**	**Elective**
(2 courses; 6 cr.)	(3 courses; 9 cr.)	(1 course; 3 cr.)
B104	3 courses from:	1 additional
B105	B307 B344	psychology course
	B310 B356	
	B320 B370	
	B334 B380	
	B340 B424	

No grade lower than C– is acceptable for any course in the minor.

A minimum grade point average of 2.0 in minor courses is required.

A minimum of 9 credit hours of the minor must be taken at IUPUI.

Correspondence courses may not be used to fulfill requirements for the minor.

Psychology Plans of Study

There is no single semester-by-semester plan of study for any of the degrees offered by the Department of Psychology. However, one possible sequence of courses for the B.A. degree and one for the B.S. degree are given in the sample program that follows.

Bachelor of Arts Sample Program (124 cr.)

Freshman Year

First Semester

PSY B104 Psychology as a Social Science.....3
COMM C110 Fundamentals of Speech Communication.....3
ENG W131 Elementary Composition I.....3
Arts and Humanities Elective.....3
Social and Behavioral Sciences Elective.....3
15

Second Semester

PSY B105 Psychology as a Biological Science.....3
CSCI 207 Computers in the Social Sciences.....3
ENG W132 Elementary Composition II.....3
MATH 118 Finite Mathematics.....3
Physical and Biological Sciences Elective.....3-5
15-17

Sophomore Year

Third Semester

PSY B305 Statistics.....3
PSY Core Courses.....6
Arts and Humanities Elective.....3-5
Physical and Biological Sciences Elective.....3-5
15-19

Fourth Semester

PSY B211 Introductory Laboratory in Psychology.....3
Arts and Humanities Electives.....6
Social and Behavioral Sciences Electives.....6
15

Junior Year

Fifth Semester

PSY Core Courses.....6
PSY Elective.....3
Physical and Biological Sciences Elective.....3-5
Social and Behavioral Sciences Elective.....3
15-17

Sixth Semester

PSY Advanced Laboratory.....3
PSY Core Course.....3
PSY Elective.....3
Electives.....6-8
15-17

Senior Year

Seventh Semester

PSY Core Course.....3
PSY Elective.....3
Physical and Biological Sciences Elective.....3-5
Electives.....6-9
15-20

Eighth Semester

Electives.....15-17

Bachelor of Science Sample Program (124 cr.)

Freshman Year

First Semester

PSY B104 Psychology as a Social Science.....3
COMM C110 Fundamentals of Speech Communication.....3
ENG W131 Elementary Composition I.....3
Arts and Humanities Elective.....3
Social and Behavioral Sciences Elective.....3
15

Second Semester

PSY B105 Psychology as a Biological Science.....3
CSCI 207 Computers in the Social Sciences.....3
ENG W132 Elementary Composition II.....3
MATH 118 Finite Mathematics.....3
Physical and Biological Sciences Elective.....3-5
15-17

Sophomore Year

Third Semester

PSY B305 Statistics.....3
PSY Core Courses.....6
Arts and Humanities Elective.....3
Physical and Biological Sciences Elective.....3-5
15-17

Fourth Semester

PSY B211 Introductory Laboratory in Psychology.....3
MATH M119 Brief Survey of Calculus I.....3
PSY Core Course.....3
Social and Behavioral Sciences Elective.....3
Elective.....3
15

Junior Year

Fifth Semester		Sixth Semester	
PSY Core Courses	6	**PSY** Advanced Laboratory	3
PSY Elective	3	**PSY** Core Course	3
Physical and Biological Sciences Elective	3-5	**PSY** Elective	3
Elective	3	Electives	6-9
	15-17		15-18

Senior Year

Seventh Semester		Eighth Semester	
PSY Electives	6	**PSY** Elective	3
Physical and Biological Sciences Elective	3-5	Electives	12-15
Electives	6		15-18
	15-17		

Undergraduate Honors Program in Psychology

Psychology majors admitted to the IUPUI Honors Program will be eligible to participate in all psychology honors courses and to graduate with honors in psychology. Usually honors credit is based on individual student-faculty agreement to enhance normal course requirements. Students who are not in the IUPUI Honors Program but who meet the minimum GPA criterion will be able to participate in honors courses but will not receive honors credit. For currently enrolled students (who have completed at least 12 credit hours), the GPA criterion for admission to the honors program is 3.3. For new students, the criteria for admission are SAT scores of 1200 or graduation in the top 10 percent of the high school class.

To graduate with honors, students may choose one of two tracks: *Track one:* The student must earn at least 24 hours of honors credit, 6 of which must be in psychology and 6 of which must be outside of psychology (the remaining 12 can be either). At least 3 hours of this credit must be PSY B499 Honors Research, which should culminate in an honors thesis. *Track two:* The student must earn at least 21 hours of honors credit, 6 of which must be in psychology and 6 of which must be outside of psychology (the remaining hours can be from either). At least 6 hours of the credit must be a research project culminating in a psychology thesis. In this track the university honors council must approve the project proposal. In both tracks only grades of A or B will count for honors credit. To graduate with honors, the student must have an overall GPA of 3.3 with a GPA of at least 3.5 in honors and psychology courses.

For additional information, contact the director of the IUPUI Honors Program, Education/Social Work Building 2126, 902 W. New York Street, IUPUI, Indianapolis, IN 46202-5154 [(317) 274-2660] or a psychology adviser.

Psi Chi Honorary Society To become a member of the Psi Chi Honorary Society the undergraduate student must have an overall GPA of 3.0, and a GPA of 3.5 in psychology. The life membership fee is $25. Interested students should submit an application to the Psi Chi faculty adviser.

Graduate Programs

The department offers Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degree programs. At the M.S. level, programs are currently offered in industrial/organizational psychology and clinical rehabilitation psychology. At the Ph.D. level, an emphasis is currently offered in clinical rehabilitation psychology.

M.S. Programs

Graduate training at the M.S. level is designed to provide students with theory and practice that will enable them to apply psychological techniques and findings in a subsequent job setting. The M.S. degree may be completed on a full- or part-time basis and normally takes two or three years to finish. Depending on the case, a minimum of 36 credit hours is required, including departmental core, area core, and elective courses. All students admitted after fall 1992 must complete a thesis as a degree requirement.

Industrial/Organizational Psychology The industrial/organizational emphasis is designed to provide students with the necessary knowledge and skills to work in personnel and other human

resource areas. The course content of the program emphasizes the traditional personnel functions of selection, training, and performance evaluation. In addition, students become acquainted with other human resource functions such as leadership, job design, group processes for decision making, and the analysis of work motivation and satisfaction as related to individual adjustment and organizational effectiveness. Through selection of elective courses and topics for supervised individual research, a student can specialize in either traditional personnel or other human resource functions. The program follows the applied research (i.e., scientist/practitioner) model, which means that students are taught analytic methods for diagnosing organizational problems, developing solutions, and evaluating the effectiveness of those solutions.

Clinical Rehabilitation Psychology Traditionally, training programs in rehabilitation counseling have focused on helping people with disabilities adjust to their immediate environment, community, or society through individual and/or group counseling. A major goal is to assist them in entering or reentering the work force. While retaining essential elements of the conventional approach, the M.S. concentration in clinical rehabilitation provides training directed at the development of the student as an agent of social change. Toward that end, institutional structures and dynamics are examined to help students understand how these systems impinge on and affect the lives of all people in general and of minority groups in particular. At the master's level, the rehabilitation counselor is a key member of the rehabilitation team, which may include a physician, psychologist, social worker, physical therapist, occupational therapist, special teacher, and/or other professional personnel. Typically, the counselor is responsible for the coordination and integration of services provided by these people. The counselor provides continuing services throughout the rehabilitation process with the goal of restoring persons with disabilities to the fullest possible physical, mental, social, vocational, and economic usefulness.

Ph.D. Program in Clinical Rehabilitation Psychology

Utilizing a scientist-practitioner model, this program is designed to integrate the assessment and intervention skills traditionally associated with clinical psychology and rehabilitation psychology's emphasis on optimizing the adaptation of persons with disabilities and chronic illnesses to the community. Graduates of the program will be qualified to assume positions as executives, direct-service providers, planners, academicians, trainers, evaluators, researchers, and consultants. The emphasis of the program is on rigorous academic training, combined with practical application in a wide variety of rehabilitation centers available in Indianapolis and elsewhere. Full-time study and a minimum of 78 credit hours (postbaccalaureate) are required, and the program is expected to take five years to complete. The program includes diverse training in psychology, including a psychology core, statistics and measurement, rehabilitation psychology, internships and practica, and an empirical thesis and doctoral dissertation. Rehabilitation specialty courses covering a broad range of disabling conditions and intervention techniques are offered.

Interested students should contact the Department of Psychology; Science, Engineering, and Technology III, Room 3124; 402 N. Blackford Street; IUPUI; Indianapolis, IN 46202-3275 [(317) 274-6945].

Financial Support

Financial support for eligible graduate students at both the M.S. and Ph.D. levels is available through teaching and research assistantships, tuition stipends, and fellowships. All assistantships require a minimum of 20 hours of work per week and include at least partial tuition remission in addition to salary.

Admission Requirements

Undergraduate training in psychology, mathematics, and the physical sciences is highly desirable, though not required. Applicants should have had at least one undergraduate course in statistics, as well as in tests and measurements. If those courses have not been completed, the student will be required to complete them as prerequisites for admission to the program.

For an applicant to be considered for unconditional admission to the terminal M.S. program, the applicant must obtain (a) a baccalaureate degree from a college or university of recognized standing; (b) a GPA of 3.0 or higher on a 4.0 scale; (c) a minimum GRE score (verbal and quantitative) of 1100 with a quantitative score of at least 550; and (d) three favorable letters of recommendation. The student who does not meet the above standards but shows potential for graduate studies could be recommended for conditional admission. Usually, the department will

specify a minimum standard of performance that must be satisfied by the student after conditional admission in order to continue.

The Ph.D. program seeks talented and motivated persons who have an interest in psychology and rehabilitation and who have the potential to make creative contributions as clinical rehabilitation psychologists. Admission to the Ph.D. program is competitive and only under unusual circumstances will students be considered for admission if they fail to meet the following minimum standards: (a) an undergraduate and graduate grade point average of 3.2 or higher on a 4.0 scale; (b) a minimum composite GRE score (verbal and quantitative) of 1200; (c) three favorable letters of recommendation; and (d) a personal statement displaying an interest in the field of clinical rehabilitation psychology. Prior experience in rehabilitation is desirable but not required for admission.

Admissions Information

Students interested in information about admission to graduate programs in this department should write directly to the graduate secretary, Department of Psychology; Science, Engineering, and Technology III, Room 3124; 402 N. Blackford Street; IUPUI; Indianapolis, IN 46202-3275.

Research Facilities

The Department of Psychology has extensive laboratory and computer facilities to support faculty and student research. More than 8,000 square feet of laboratory space in the new School of Science complex is devoted to psychological research in the areas of clinical rehabilitation psychology, industrial/organizational psychology, life-span development, cognition, and sensation and perception. Separate animal quarters and modern laboratories are also available to support research in animal experimental psychology and psychobiology. Computer support includes microcomputer clusters and networks within the department and terminal connections to several mainframe computers. Internship and practicum sites are available at the Indiana University Medical Center and with numerous other organizations in the metropolitan Indianapolis area.

Transfer Credit

A maximum of 12 credit hours can be transferred into the M.S. program, and a maximum of 36 credit hours can be transferred into the doctoral program. Transfer hours will be accepted only if they are appropriate and judged acceptable by the student's plan-of-study committee.

Temporary Student Status

A student may enroll in some graduate program courses without formal admission after making application as a temporary graduate student. No more than 12 hours of credit may be applied to an advanced degree program if an individual is later admitted as a regular graduate student. However, if an application to a regular degree program is approved during the session in which a person is enrolled for the 12th credit hour as a nondegree registrant, then all credits taken prior to and during that term will be eligible for inclusion in a plan of study for a degree program. For inclusion, the courses must be appropriate to the degree program and acceptable to the department and the Graduate School. No course in which a grade of less than B has been received will be permitted in a plan of study if the course was taken while the student was enrolled as a nondegree registrant. Nondegree registrants may be required to secure consent from each of the departments in which they would like to register for courses.

Research Interests of Faculty

Major research interests of faculty include the following: applied behavior analysis, applied experimental psychology, applied social psychology, biofeedback, cross-cultural investigations, industrial/organizational psychology, quantitative psychology, measurement theory and development, physiological psychology, program planning and evaluation, clinical rehabilitation psychology, and vocational and prevocational training of persons with disabilities. A current and more detailed listing of faculty research interests is available from the department.

Courses in Psychology (PSY)

Note: P—prerequisite; C—corequisite; Fall—offered fall semester; Spring—offered spring semester; Summer—offered during the summer session. For courses with no designated semester, consult the Schedule of Classes. Equiv.—course is equivalent to the indicated course taught at Indiana University Bloomington, or the indicated course taught at Purdue University, West Lafayette.

Undergraduate Level

B104 Psychology as a Social Science (3 cr.) Equiv. to IU PSY P102 and PU PSY 120. Fall, Spring, Summer. Introduction to scientific method, individual differences, personality, developmental, abnormal, social, and industrial psychology.

B105 Psychology as a Biological Science (3 cr.) Equiv. to IU PSY P101 and PU PSY 120. Fall, Spring, Summer. Research methods and content areas of learning, sensation-perception, psychophysiology, motivation, emotions, and statistics.

B211 Introductory Laboratory in Psychology (3 cr.) P: B105. Equiv. to IU PSY P111, P211 and PU PSY 200. Fall, Spring. Introductory laboratory in experimental methods and statistical treatment of data in several areas of psychology; introduction to experimental report writing.

B252 Topics in Psychology (1-3 cr.) Topics in psychology and interdisciplinary applications. May be repeated, provided different topics are studied, for a maximum of 4 credit hours.

B292 Readings and Research in Psychology (1-3 cr.) P: Consent of instructor. Fall, Spring. Independent readings and research on psychology problems. For freshman and sophomore students only.

B305 Statistics (3 cr.) P: B104 or B105, and 3 credits of math that carry School of Science credit. Equiv. to IU PSY P354, K300, K310 and PU PSY 301. Fall, Spring, Summer. Introduction to basic statistical concepts; descriptive statistics and inferential statistics.

B307 Tests and Measurement (3 cr.) P: 3 credit hours of psychology and B305. Equiv. to PU PSY 302. An introduction to psychological measurement, including psychophysics, scaling techniques, psychological testing, and individual differences.

B310 Life Span Development (3 cr.) P: 3 credit hours of psychology. Fall, Spring, Summer. This course emphasizes the life span perspective of physical and motor, intellectual and cognitive, language, social and personality, and sexual development. Commonalities across the life span, as well as differences among the various segments of the life span, are examined. Theory, research, and practical applications are equally stressed.

B320 Physiological Psychology (3 cr.) P: B105. Equiv. to IU PSY P326 and PU PSY 329. Review of necessary background in neurophysiology and neuroanatomy followed by the relationship of physiology to sensory processes, motivation, and learning. Emphasis on research with animals.

B334 Perception (3 cr.) P: B105. Equiv. to IU PSY P329 and PU PSY 310. Consideration of the concepts and research in perception. Relation of sense organ systems to human behavior. Some attention to social and cultural factors.

B340 Cognition (3 cr.) P: B105 or consent of instructor. A survey of information-processing theories from historical antecedents through current theories. Research methodology and theory will be emphasized throughout the discussion of issues such as perception, attention, memory, reasoning, and problem solving.

B344 Learning (3 cr.) P: B105. Equiv. to IU PSY P325 and PU PSY 311. History, theory, and research involving human and animal learning and cognitive processes.

B354 Adult Development and Aging (3 cr.) P: B310 or consent of instructor. The course examines changes that occur with age in the following areas: intelligence, memory, personality, sexuality, health, living environments, economics, developmental disorders, and treatment for developmental disorders.

B356 Motivation (3 cr.) P: 3 credit hours of psychology. Equiv. to IU PSY P327 and PU PSY 333. Study of motivational processes in human and animal behavior, how needs and incentives influence behavior, and how motives change and develop.

B360 Child and Adolescent Psychology (3 cr.) P: B310 or consent of instructor. Equiv. to IU PSY P316 and PU PSY 235. Development of behavior in infancy, childhood, and adolescence, including sensory and motor development and processes such as learning, motivation, and socialization.

B366 Introduction to Organizational Psychology in Business and Industry (3 cr.) The study of organizational psychology as applied to business and industry. Brief coverage of historical development of organizational theory through exploring

current theories' weaknesses and strengths. Special problems for business and industry and the methodology for scientific research on these problems will be presented. Some areas or problems to be discussed are organizational structure and climate, leadership and management, communication, motivation, morale, and productivity.

B368 Introduction to Personnel Psychology in Business and Industry (3 cr.) Psychological methods of assessment in personnel selection and placement, evaluation, and training. Methods and problems of psychological measurement, occupational analysis, human factors engineering, job evaluation, and wages and salary administration.

B370 Social Psychology (3 cr.) P: 3 credit hours of psychology. Equiv. to IU PSY P420 and PU PSY 340. Fall, Spring, Summer. Study of the individual in social situations including socialization, social perception, social motivation, attitudes, social roles, and small group behavior.

B372 Practicum in Industrial Psychology (3 cr.) P: B366 and B368 or equivalent. This course will provide students with work experience, one day per week, in local organizations. Practice will be obtained in using the applied skills of industrial psychology to solve actual organizational problems.

B374 Group Dynamics Theory and Research (3 cr.) P: B370. An intensive survey of research and theory on the behavior of small groups and the research methods by which groups are studied.

B376 The Psychology of Women (3 cr.) P: 3 credit hours of psychology. Equiv. to IU PSY P460. A survey of topics in psychology as related to the biological, social, and psychological development of women in modern society.

B380 Abnormal Psychology (3 cr.) P: 3 credit hours of psychology. Equiv. to IU PSY P324 and PU PSY 350. Fall, Spring, Summer. Various forms of mental disorders with emphasis on cause, development, treatment, prevention, and interpretation.

B420 Humanistic Psychology (3 cr.) A comprehensive survey of the field of humanistic psychology. The course will explore human experience as a focal point in the study of psychology. The instructor will utilize didactic and experiential teaching methods.

B423 Laboratory in Physiological Psychology (3 cr.) P: B211, B305, and B320. Equiv. to IU PSY P426 and PU PSY 427. Experiments and demonstrations in physiological psychology.

B424 Theories of Personality (3 cr.) P: 9 credit hours of psychology. Equiv. to IU PSY P319 and PU PSY 423. Methods and results of the scientific study of personality, including the development, structure, and functioning of the normal personality.

B425 Laboratory in Personality (3 cr.) P: B211, B424, and B305. Equiv. to PU PSY 424. Demonstrations and experiments in personality research.

B431 Laboratory in Sensation and Perception (3 cr.) P: B211, B305, and B324 or B334. Equiv. to IU PSY P424 and PU PSY 312. Experiments and demonstrations in sensation and perception with an emphasis on their physiological basis.

B445 Laboratory in Learning (3 cr.) P: B211, B305, and B344. Equiv. to IU PSY P436 and PU PSY 312. Experiments and demonstrations involving learning and cognitive processes.

B452 Seminar in Psychology (1-3 cr.) P: Consent of instructor. Topics in psychology and interdisciplinary applications. May be repeated, provided different topics are studied, for a maximum of 6 credit hours.

B457 Laboratory in Motivation (3 cr.) P: B211, B305, and B356. Equiv. to IU PSY P436 and PU PSY 312. Experiments and demonstrations in motivation.

B460 Behavior Management (3 cr.) P: Consent of instructor. Equiv. to IU PSY P468. Conducted as a seminar and a practicum for psychology majors and teachers in the principles and methods of behavior management.

B461 Laboratory in Developmental Psychology (3 cr.) P: B211, B305, and B310 or B360. Equiv. to IU PSY P429. Principal research methods in developmental psychology and their application to selected problems.

B471 Laboratory in Social Psychology (3 cr.) P: B211 and B305. P or C: B370. Equiv. to IU PSY P421 and PU PSY 346. Observational, correlational, and experimental studies in social psychology.

B472 Practicum in Group Dynamics (3 cr.) P: 6 credit hours of psychology and consent of instructor. Equiv. to IU PSY P321 and PU PSY 348. Application in the field of group dynamics through experience as a participant in group sensitivity training.

B492 Readings and Research in Psychology (1-3 cr.) P: Consent of instructor. Equiv. to IU PSY P495 and PU PSY 498. Fall, Spring, Summer. Independent readings and research on psychological problems.

B499 Honors Research (cr. arr.) P: Consent of departmental honors committee. Equiv. to IU PSY P499 and PU PSY 499. Fall, Spring,

Summer. Independent readings and research resulting in a research paper.

Graduate Level

540 History of Psychology (3 cr.) P: 9 credit hours of psychology. A review of the philosophical, theoretical, and methodological issues that entered into the development of modern psychology. Emphasis is placed on historical themes that continue to be active in the science and profession of psychology.

I549 Introduction to Vocational Rehabilitation (3 cr.) P: 9 credit hours of psychology. Philosophy, procedures, and practices underlying the vocational rehabilitation movement, including the historical, social, cultural, and economic factors and recent legislation that have contributed to its rapid development.

I552 Psychological Counseling Theory and Practice in Rehabilitation (3 cr.) P: 9 credit hours of psychology. Theories of counseling and their applicability to the individual counselor and the prospective counseling situation. The use of various tools in counseling.

I554 Psychosocial Aspects of Disability (3 cr.) P: 9 credit hours of psychology. An examination of the effect of the socioemotional impact of traumatic injury or chronic illness on human functioning and its role in the rehabilitation process.

I555 Medical Aspects of Disability (3 cr.) P: 9 credit hours of psychology including I549. Provides medical information for rehabilitation counselors and introduces students to medical terminology. Includes knowledge of the etiology, prognosis, methods of treatment, and effects of disabling conditions, and implications for the rehabilitation counselor. Counselor relationships with other health-related personnel are emphasized.

565 Interpersonal Relations (3 cr.) P: 9 credit hours of psychology. Review of major current theoretical formulations of the interpersonal relationship, including a discussion of some of the more prominent research. Focus is primarily on two-person interpersonal relations.

570 Industrial Psychology (3 cr.) Survey of the applications of psychological principles and of research methodology to the various human problems in the industry, such as personnel selection and appraisal, the organizational and social context of human work, the job and work situation, human errors and accidents, and psychological aspects of consumer behavior.

572 Organizational Psychology (3 cr.) A survey of basic behavioral science research and thinking as these contribute to the understanding of individual, dyadic, group, intergroup, and other large organization behavioral phenomena. The topics covered include motivation, perception, attitudes and morale, communication, leadership, conflict, problem solving, behavior change, and organizational effectiveness.

574 Psychology of Industrial Training (3 cr.) P: 3 credit hours of psychology. Utilization of psychological measurement techniques in assessing training needs and evaluating training effectiveness and the application of learning research and theory to industrial training.

I578 Occupational Analysis (3 cr.) P: 570. Survey of systematic study of human work, including techniques for analyzing jobs and occupations for personnel and related purposes. Survey of occupational research and related topics. Practice in job analysis.

I580 Survey of Clinical Approaches with Children and Adolescents (3 cr.) P: 9 credit hours in psychology. Introduction to the following as they relate to children and adolescents: (1) psychopathological disorders and behavior problems, (2) theories of psychopathology and behavior problems, (3) evaluation techniques, and (4) therapeutic and behavioral change procedures. This is a lecture course.

590 Individual Research Problems (1-3 cr.) P: 12 credit hours of psychology and consent of instructor. Opportunity for students to study particular problems in any field of psychology or initiate themselves into research techniques under the guidance of a member of the staff.

I595 Seminar in Teaching Psychology (0 cr.) P: Consent of the Department of Psychology. A problem-solving approach to teaching psychology at IUPUI. Planning the course; anticipating problems; dealing with ongoing teaching problems. Current faculty members will present their innovative techniques. Participants will evaluate each other's classroom performance.

600 Statistical Inference (3 cr.) P: Students must be pursuing a degree in the psychology graduate program or have the consent of the instructor. Emphasis is given to principles underlying both parametric and nonparametric inference.

601 Correlation and Experimental Design (3 cr.) P: 600. Continuation of 600 with emphasis on the design and analysis of experiments.

605 Applied Multivariate Analysis (3 cr.) P: 600. A survey of the most frequently employed multivariate research techniques, such as multivariate generalizations of univariate tests and analysis of variance, principal components, canonical analysis, and discriminant analysis. A central theme of the course is the general linear model, both univariate and multivariate. A multipurpose program for this model provides the student with practical experience in conducting multivariate research.

608 Measurement Theory and the Interpretation of Data (3 cr.) P: 600 and B307, or equivalent. The theory of measurement and the development of reliability and the Spearman-Brown equations, true scores and variables, and correction for attenuation. Variance or covariance of combinations of variables. Item analysis and test construction strategies. Reliability and validity of measurements and the influence of measurement error and measurement threats to research design.

611 Factor Analysis (3 cr.) P: 600. Theory and applications of factor analysis in psychological research.

I613 Psychiatric Rehabilitation (3 cr.) P: Consent of instructor. A seminar examining recent developments in the rehabilitation of persons with severe psychiatric disabilities, including assertive case management, vocational approaches, clubhouse models, residential alternatives, psychoeducation, and the consumer movement. Field observations complement classroom instruction. Issues in program planning and cost effectiveness will be discussed.

I614 Behavioral Medicine in Rehabilitation (3 cr.) P: Consent of instructor. The theory and practice of behavioral medicine will be explored. Emphasis is on the application of behavioral principles to individuals suffering from various chronic diseases or disabilities including spinal cord injury, chronic pain, cancer, diabetes, strokes, cardiovascular diseases, and epilepsy.

615 Introduction to Psychobiology (3 cr.) P: Consent of instructor. A survey of the integrated neurosciences for nonconcentrators emphasizing human physiological psychology. Neural processes of sensory and motor function, arousal and sleep, motivation, learning and memory, language function, and personality disorders will be presented with selected coverage of neuroanatomy, neurophysiology, neuropharmacology, and neuroendocrinology. Both normal and pathological functions will be covered.

624 Human Learning and Memory (3 cr.) P: Consent of instructor. Theory of and experimental findings in human learning and memory.

640 Survey of Social-Personality Psychology I (3 cr.) P: B370 or equivalent. An extensive survey of methods, research, and theory in social-personality psychology.

641 Survey of Social-Personality Psychology II (3 cr.) P or C: 600. An extensive survey of methods, research, and theory in social-personality psychology.

I642 Cross-Cultural Social Psychology (3 cr.) P: 600 and 640. A survey of methodology and findings from cross-cultural analysis of social behavior. Findings are applied to the development of techniques for cross-cultural training.

I643 Field Methods and Experimentation (3 cr.) P: 600. The course will cover methods appropriate for field experimentation and program evaluation. Topics will include quasi-experimental designs, sampling procedures, and issues associated with program evaluation.

646 Seminar in Social-Personality Psychology (3 cr.) P: Consent of instructor. A seminar covering a special topic in personality or social psychology. Specific topic varies from seminar to seminar.

I648 Practicum in Applied Social Psychology (3 cr.) P: Consent of instructor. Students will participate in applied research and/or program evaluation in a community agency. The field experience, combined with a seminar, will provide on-site training and skill development under the supervision of the Department of Psychology and agency personnel.

I649 Internship in Applied Social Psychology (0 cr.) P: Consent of instructor. Open only to applied social psychology students in approved internship facilities. Provides opportunity for application of knowledge of program evaluation and/or social research under supervision of the agency and monitored by the Department of Psychology.

I650 Developmental Psychology (3 cr.) Major concepts, principles, and facts concerning the biological and environmental influences on behavioral and psychological development. Particular emphasis given to essential principles of ontogenetic development (life span) emerging from current research in genetics and psychology.

655 Cognitive Development (3 cr.) P: Consent of instructor. An analysis of research findings and current theories relevant to the development of cognitive processes. Emphasis

is placed on the changing characteristics of some fundamental cognitive processes. Special attention is given to verbal behavior and language.

I664 Psychological Assessment in Rehabilitation I (3 cr.) P: Consent of instructor. Presentation of general principles of psychological assessment, professional practice, interviewing, intelligence/cognitive assessment, and psychological report writing. Supervised practice in the development of direct service skills in interviewing, behavioral observation, and psychometric assessment of cognitive abilities. Emphasis will be on functional implications of test results for rehabilitation populations.

I665 Intervention I: Counseling Approaches (3 cr.) P: Consent of instructor. This course will introduce the doctoral student to intervention procedures used in rehabilitation psychology. The course has both a didactic and clinical skills component, involving traditional counseling interventions, behavior therapy, and biofeedback. Applications to disabled populations will be emphasized.

I666 Intervention II: Applied Behavior Analysis (3 cr.) P: Consent of instructor. The course is designed to provide an advanced introduction to the philosophy, principles, and procedures of applied behavior analysis and a review of selected research. Practical, ethical, and legal constraints on behavior interventions will be considered. Research conducted in institutional, educational, and home settings will be emphasized.

I669 Psychological Assessment in Rehabilitation II (3 cr.) P: I664 and consent of instructor. Presentation of psychometric foundations and the basic prediction model in personality/interest assessment. Coverage of the history of personality, assessment, personality development, and supervised clinical practice in personality/interest assessment in rehabilitation. Emphasis is on prediction of everyday functioning.

680 Seminar in Industrial-Personnel Psychology (3 cr.) P: 570, 572, and 601. (Formerly numbered 681.) Extensively surveys the various areas of industrial-personnel psychology (e.g., selection, placement, training, performance appraisal). Course provides a critical and up-to-date review of recent and classical research in these areas.

681 Seminar in Research Methodologies of Industrial/Organizational Psychology (3 cr.) P: 570, 572, 601 or consent of instructor. (Formerly numbered 680.) Intensive analysis of application of various research and statistical methods to the study of human behavior in organizational settings.

682 Advanced Seminar in Industrial/Organizational Psychology (3 cr.) P: 570, 572, or equivalent. Special topics in industrial and organizational psychology are offered on a rotating basis. Examples of the special topics are work motivation, leadership, advanced selection and placement, and performance appraisal. One topic will be treated each semester.

683 Seminar in Industrial-Social Psychology (3 cr.) P: 570, 572, or equivalent. Study of research and theory emphasizing social perception, attitudes, supervisory behavior, employee participation, motivation, and organizational structure.

684 Practicum in Industrial/Organizational Psychology (3 cr.) P: 570, 572, and consent of instructor. Practical experience in the development and implementation of field research in organizational settings. This course will give students the opportunity to spend eight hours per week within local business organizations in order to gain experience and skills in industrial/organizational psychology.

I689 Practicum in Rehabilitation Psychology (3 cr.) P: I549 and consent of instructor. Supervised practice of rehabilitation psychology in a community agency or organization.

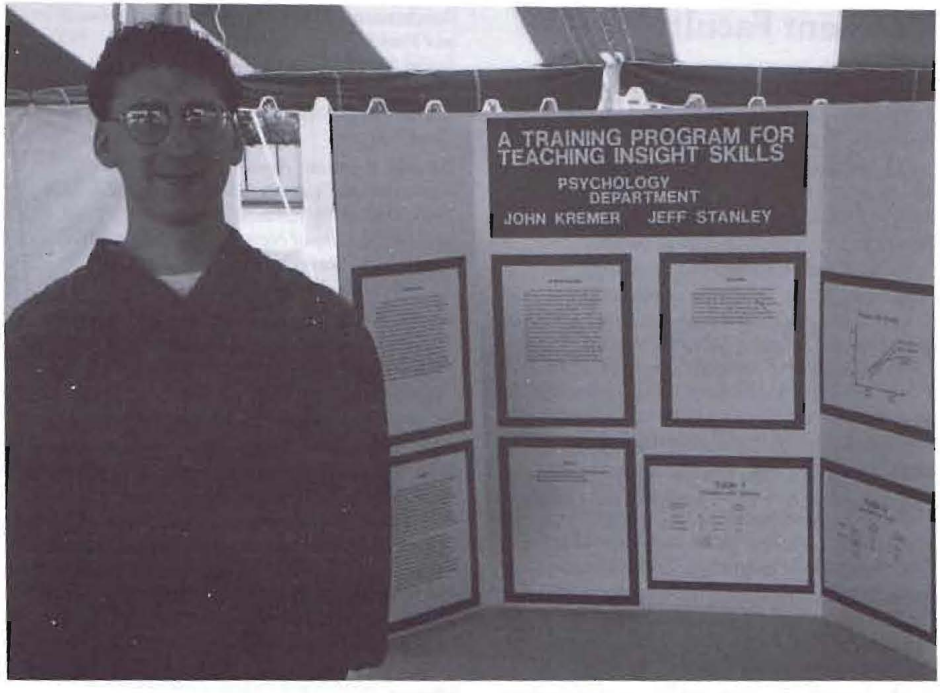
I690 Career Development, Selection, and Placement in Rehabilitation (3 cr.) P: 9 credit hours of psychology. A survey of current methods and criteria used in job development, selective placement, and follow-up of handicapped and deprived individuals.

I691 Seminar in Rehabilitation Psychology (3 cr.) P: Consent of instructor. Current trends, problems, and developments in rehabilitation. Students pursue a special interest and share information and experience with the group. Individual reports and group discussions.

I697 Internship in Rehabilitation Psychology (0-9 cr.) P: Consent of instructor. Opportunities for application of theory and practice of rehabilitation psychology and case management in a rehabilitation setting under supervision of the Department of Psychology and the agency.

698 Research M.S. Thesis (3 cr.)

699 Research Ph.D. Thesis (0-12 cr.)


A TRAINING PROGRAM FOR
TEACHING INSIGHT SKILLS
PSYCHOLOGY
DEPARTMENT
JOHN KREMER JEFF STANLEY

Resident Faculty

Abramovich, Yuri A., *Associate Professor of Mathematical Sciences (1989); M.S., 1968, Ph.D., 1972, Leningrad State University, U.S.S.R.* Specialty: Functional Analysis.

Alexy, William D., *Adjunct Assistant Professor of Psychology (1992); B.A., 1971, Concord College; M.A., 1972, Radford University; Ph.D., 1981, State University of New York at Buffalo.* Specialty: Rehabilitation Counseling.

Aliprantis, C. D., *Professor of Mathematical Sciences, School of Science, and Adjunct Professor of Economics, School of Liberal Arts (1975); B.S., 1968, University of Athens, Greece; M.S., 1971, Ph.D., 1973, California Institute of Technology.* Specialties: Functional Analysis, Operator Theory, Mathematical Economics.

Banaszak, Konrad J., *Adjunct Professor of Geology; B.S., 1966, Beloit College; M.S., 1969, Ph.D., 1975, Northwestern University.* Specialties: Low Temperature Geochemistry, Environmental Hydrology, Economic Geology.

Bard, Martin, *Professor of Biology (1975); B.S., 1965, City College of New York; Ph.D., 1971, University of California, Berkeley.* Specialty: Biochemical Genetics.

Barth, Andrew P., *Assistant Professor of Geology (1989); B.S., 1981, M.S., 1985, California State University, Los Angeles; Ph.D., 1989, University of Southern California.* Specialties: Petrology, Geochemistry, Economic Geology.

Bayer, Shirley A., *Professor of Biology (1982); B.A., 1963, St. Mary-of-the-Woods; M.A., 1969, California State University, Fullerton; Ph.D., 1974, Purdue University.* Specialty: Neurobiology.

Bittinger, Marvin, *Professor of Mathematical Sciences (1968); B.S., 1963, Manchester College; M.S., 1965, Ohio State University; Ph.D., 1968, Purdue University.* Specialty: Mathematics Education.

Boaz, Patricia A., *Associate Professor Emerita of Chemistry (1967); B.S., 1944, Vassar College; Ph.D., 1951, State University of Iowa.* Specialties: General Chemistry, Physical Chemistry, Geochemistry.

Bond, Gary R., *Professor of Psychology (1983); B.S., 1966, Michigan State University; M.A., 1972, Ph.D., 1975, University of Chicago.* Specialties: Psychiatric Rehabilitation, Program Evaluation.

Borden, Victor, M. H., *Assistant Professor of Psychology and Director of Information Management and Institutional Research (1992); B.A., 1979, University of Rochester; M.S., 1983, Ph.D., 1987, University of Massachusetts–Amherst.* Specialties: Statistical Methods, Multivariate Analysis, Secondary Data Analysis, Student Life Research.

Boschmann, Erwin, *Associate Dean of Faculties and Professor of Chemistry (1968); B.A., 1963, Bethel College (Kansas); M.S., 1965, Ph.D., 1968, University of Colorado.* Specialties: General Chemistry, Inorganic Chemistry, Bioinorganic Chemistry.

Boukai, Benzion, *Assistant Professor of Mathematical Sciences (1990); B.A., 1983, M.A., 1985, University of Haifa, Israel; Ph.D., 1988, State University of New York at Binghamton.* Specialties: Statistical Theory, Applied Statistics, Applied Probability.

Boyd, Donald, *Adjunct Professor of Chemistry (1986); B.S., 1963, Pennsylvania State University; Ph.D., 1968, Harvard University.* Specialty: Organic Chemistry.

Breen, John J., *Assistant Professor of Chemistry (1992); B.S., 1981, Providence College; Ph.D., 1988, Pennsylvania State University.* Specialties: Analytical Chemistry, Surface Probe Microscopy.

Bringle, Robert Gordon, *Associate Professor of Psychology (1974); B.A., 1969, Hanover College; M.S., 1972, Ph.D., 1974, University of Massachusetts.* Specialties: Social Psychology, Program Evaluation, Methodology.

Burkinshaw, Owen, *Professor of Mathematical Sciences, (1972); B.S., 1966, M.S., 1968, Ohio University; Ph.D., 1972, Purdue University.* Specialty: Functional Analysis.

Chandrasekhar, Srinivasan, *Adjunct Assistant Professor of Biology (1987); B.Sc., 1970, M.S., 1973, University of Madras, India; M.Sc., 1977, Ph.D., 1981, State University of New York at Albany.* Specialty: Developmental Biology.

Chernoff, Ellen A. G., *Associate Professor of Biology (1986); B.A., 1973, Ph.D., 1978, University of Chicago.* Specialty: Developmental Biology.

Chin, Raymond C. Y., *Chairperson and Professor of Computer and Information Science (1990); B.A.E., 1962, M.A.E., 1964, Rensselaer Polytechnic Institute; Ph.D., 1970, Case Western Reserve University.* Specialties: Parallel Solution of Partial Differential Equations, Asymptotic-numerical Methods.

Clack, James W., *Assistant Professor of Biology (1990); B.A., 1974, Indiana University; Ph.D., 1982, Purdue University.* Specialties: Neurobiology, Visual Physiology.

Cox, Robert W., *Assistant Professor of Computer and Information Science and of Mathematical Sciences (1991); B.S., 1976, Ph.D., 1988, California Institute of Technology.* Specialties: Scientific Computation, Applied Mathematics.

Crowell, Dring N., *Assistant Professor of Biology (1991); B.S., 1981, Illinois State University; Ph.D., 1987, University of Wisconsin.* Specialty: Molecular Biology.

Cutshall, Theodore W., *Associate Professor of Chemistry (1961); B.S.Ch.E., 1949, Purdue University; M.S., 1959, Ph.D., 1964, Northwestern University.* Specialty: Organic Chemistry.

Davis, Robert, *Professor of Psychology (1976); B.S., 1958, Salisbury State University; M.Ed., 1962, Pennsylvania State University; Ed.D., 1968, University of Maryland.* Specialties: Rehabilitation Psychology, Family Therapy.

de Caprariis, Pascal, *Associate Professor of Geology (1978); B.S., 1964, M.S., 1967, Boston College; Ph.D., 1973, Rensselaer Polytechnic Institute.* Specialties: Geophysics, Quantitative Hydrology.

Dey, Tamal Krishna, *Assistant Professor of Computer and Information Science (1992); B.E., 1985, Jadavpur University, India; M.E., 1987, Indian Institute of Science, India; Ph.D., 1991, Purdue University.* Specialties: Analysis of Algorithms, Computational Geometry, Computer Graphics.

Dubin, Paul, *Professor of Chemistry (1981); B.S., 1962, City University of New York; Ph.D., 1970, Rutgers University.* Specialties: Analytical Chemistry, Polymer Chemistry.

Dykstra, Clifford E., *Associate Dean for Research and Graduate Studies, School of Science, and Professor of Chemistry (1990); B.S. (Chemistry) and B.S. (Physics), 1973, University of Illinois; Ph.D., 1976, University of California, Berkeley.* Specialties: Theoretical and Computational Chemistry.

Evenbeck, Scott, *Associate Vice Chancellor for Undergraduate Education, Director of Undergraduate Education Center, and Associate Professor of Psychology (1972); A.B., 1968, Indiana University; M.A., 1971, Ph.D., 1972, University of North Carolina.* Specialties: Social Psychology, Program Evaluation, Methodology.

Fetterman, John G., *Associate Professor of Psychology (1989), B.A., 1973, Alma College; M.A., 1977, Hollins College; Ph.D., 1982, University of Maine.* Specialty: Learning.

Fife, Wilmer K., *Professor of Chemistry (1971); B.S., 1955, Case Institute of Technology; Ph.D., 1960, Ohio State University.* Specialties: General Chemistry, Organic Chemistry, Biochemistry.

Fleener, Don E., *Associate Professor Emeritus of Psychology (1966); B.S. (Ed), 1949, Indiana Central College; Ph.D., 1967, Indiana University.* Specialties: Behavioral Medicine, Clinical Psychology, Developmental Psychology.

Fortier, Robert H., *Associate Professor Emeritus of Psychology (1966); B.S., 1947, Ph.D., 1952, Western Reserve University.* Specialties: Child Psychology, Personality.

Frankel, Michael L., *Assistant Professor of Mathematical Sciences (1984); M.S., 1971, Novosibirsk State University, U.S.S.R.; Ph.D., 1984, Tel Aviv University, Israel.* Specialty: Applied Mathematics.

Fricke, Gordon H., *Associate Dean for Development and External Affairs, School of Science, and Associate Professor of Chemistry (1972); B.A., 1964, Goshen College; M.S., 1966, State University of New York at Binghamton; Ph.D., 1970, Clarkson College of Technology.* Specialties: General Chemistry, Analytical Chemistry.

Froehlke, Kristin, *Adjunct Professor of Computer and Information Science (1981); B.A., 1968, Marion College; M.S., 1970, Purdue University.* Specialty: Computer Science.

Gersting, John M., Jr., *Professor of Computer and Information Science (1970); B.S., 1962, Purdue University; M.S., 1964, Ph.D., 1970, Arizona State University.* Specialties: Database Systems, User Interface Design.

Gersting, Judith L., *Professor of Computer and Information Science (1970); B.S., 1962, Stetson University; M.A., 1964, Ph.D., 1969, Arizona State University.* Specialties: Logic, Fault-tolerant Computing.

Ghosh, Swapan K., *Adjunct Associate Professor of Geology (1988); M.S., 1973, University of Wisconsin, Milwaukee; Ph.D., 1975, Syracuse University.* Specialties: Environmental Geology, Sedimentary Geochemistry.

Glueckauf, Robert L., *Assistant Professor of Psychology, School of Science; Adjunct Assistant Professor of Clinical Psychology in Psychiatry, School of Medicine; and Adjunct Assistant Professor of Nursing, School of Nursing (1988); B.A., 1975, University of Florida, Gainesville; M.S., 1979, Ph.D., 1981, Florida State University.* Specialty: Rehabilitation Psychology.

Goldberg, Carlos L., *Associate Professor of Psychology, (1969); B.A., 1961, Brooklyn College; M.A., 1964, Ph.D., 1969, City University of New York.* Specialties: Social Psychology, Panic Disorder, Agoraphobia, Obsessive-Compulsive Disorder.

Goodlett, Charles R., *Associate Professor of Psychology (1993); B.S., 1977, University of Kentucky; M.A., 1981, Ph.D., 1983, State University of New York at Binghamton.* Specialty: Biopsychology.

Guare, John C., *Assistant Professor of Psychology (1992); B.A., 1977, M.A., 1982, State University of New York College at Brockport; Ph.D., 1991, University of Pittsburgh.* Specialty: Rehabilitation Psychology.

Haitjema, Hendrick M., *Associate Professor of Geology (part-time), School of Science, and Associate Professor of Public and Environmental Affairs, School of Public and Environmental Affairs (1989); M.S., 1976, Delft University of Technology, Netherlands; Ph.D., 1982, University of Minnesota.* Specialties: Geohydrology, Groundwater Mechanics, Soil Mechanics.

Hall, Robert D., *Associate Professor of Geology (1974); B.S., 1963, Purdue University; M.S., 1966, University of Colorado; Ph.D., 1973, Indiana University.* Specialties: Geomorphology, Environmental Geology, Hydrology, Physical Geology.

Hanford, Peter Vance, *Professor Emeritus of Psychology (1960); B.S., 1952, M.S., 1953, Ph.D., 1958, Pennsylvania State University.* Specialties: Experimental Analysis of Behavior, Motivation.

Hazer, John T., *Associate Professor of Psychology (1975); B.A., 1970, Miami University; M.A., 1974, Ph.D., 1976, Bowling Green State University.* Specialties: Industrial/Organizational Psychology, Human Resource Management.

Hengst, James C. D., *Adjunct Assistant Professor of Biology (1991); B.S., 1975, Eureka College; Ph.D., 1980, University of Illinois.* Specialty: Immunology.

Highhouse, Scott, *Assistant Professor of Psychology (1992); B.A., 1987, University of Akron; M.A., 1989, Ph.D., 1992, University of Missouri at St. Louis.* Specialty: Industrial/Organizational Psychology.

Hudli, Anand V., *Assistant Professor of Computer and Information Science (1989); B.E., 1982, University of Mysore, India; M.Tech., 1985, Indian Institute of Technology, India; Ph.D., 1989, University of Nebraska, Lincoln.* Specialties: Artificial Intelligence, Logic Programming, Programming Languages, Database Systems.

Hutton, Lucreda, *Associate Professor of Mathematical Sciences (1975); B.S., 1967, Butler University; M.S., 1972, Purdue University; Ed.D., 1975, Indiana University.* Specialty: Mathematics Education.

Ingolia, Thomas D., *Adjunct Associate Professor of Biology (1983); B.S., 1974, University of Illinois; Ph.D., 1978, University of California, Berkeley.* Specialty: Biochemistry.

Jenski, Laura J., *Associate Professor of Biology (1987); B.S., 1973, M.S., 1975, Northern Illinois University; Ph.D., 1979, University of Wisconsin.* Specialty: Immunology.

Ji, Ronghui, *Assistant Professor of Mathematical Sciences (1986); B.S., 1982, University of Science and Technology of China, People's Republic of China; Ph.D., 1986, State University of New York at Stony Brook.* Specialties: Operator Algebras, K-Theory.

Jones, Cindy, *Lecturer in Mathematical Sciences (1990); B.S., 1971, Stanford University; M.S., 1990, Purdue University.* Specialty: Mathematics Education.

Juillerat, Florence, *Associate Professor of Biology (1966); B.S., 1962, M.S., 1967, Ph.D., 1974, Purdue University.* Specialties: Cell Biology, Biology for Teachers, Biology for Nonmajors.

June, Harry L., *Assistant Professor of Psychology (1992); B.S., 1979, South Carolina State College; M.A., 1986, University of the District of Columbia; M.S., 1987, Ph.D., 1990, Howard University.* Specialty: Behavioral Psychopharmacology.

Kaminker, Jerome Alvin, *Professor of Mathematical Sciences (1973); B.A., 1963, University of California, Berkeley; M.A., 1965, Ph.D., 1968, University of California, Los Angeles.* Specialties: Operator Algebras, K-Theory.

Kaplan, Jerome I., *Professor of Physics (1974); B.S., 1950, University of Michigan; Ph.D., 1954, University of California, Berkeley.* Specialties: Condensed Matter, Solar Energy, Biological Physics.

Keck, Robert William, *Professor of Biology (1972); B.A., 1962, M.S., 1964, University of Iowa; Ph.D., 1968, Ohio State University.* Specialty: Plant Physiology.

Kemple, Marvin D., *Associate Professor of Physics (1977); B.S., 1964, Purdue University; M.S., 1965, Ph.D., 1971, University of Illinois.* Specialties: Magnetic Resonance, Biological Physics.

Kleiner, Kathleen A., *Assistant Professor of Psychology (1987); B.A., 1981, Franklin and Marshall College; M.A., 1985, Ph.D., 1985, Case Western Reserve University.* Specialty: Cognitive Developmental Psychology.

Kleinhans, Frederick W., *Associate Professor of Physics (1972); B.S., 1965, University of Michigan; Ph.D., 1971, Ohio State University.* Specialties: Biological Physics, Computational Physics.

Kleyle, Robert M., *Professor of Mathematical Sciences (1973); B.A., 1960, Duquesne University; M.S., 1962, University of Pittsburgh; Ph.D., 1968, Harvard University.* Specialty: Statistics.

Klimek, Slawomir, *Assistant Professor of Mathematical Sciences (1991); M.Sc., 1983, Ph.D., 1988, Warsaw University, Poland.* Specialties: Mathematical Physics, Noncommutative Geometry.

Kremer, John F., *Chairperson and Associate Professor of Psychology (1975); B.A., 1966, St. Meinrad College; M.S., 1969, University of Notre Dame; M.S., 1974, Ph.D., 1975, Loyola University.* Specialties: Clinical Psychology, Evaluating Teaching, Program Evaluation.

Kuczkowski, Joseph E., *Associate Dean for Academic Programs and Student Development, School of Science, and Professor of Mathematics (1966); B.S., 1961, Canisius College; M.S., 1963, Ph.D., 1968, Purdue University.* Specialties: Semigroup Theory, Mathematics Education.

Larter, Raima M., *Professor of Chemistry (1981); B.S., 1976, Montana State University; Ph.D., 1980, Indiana University.* Specialty: Theoretical Physical Chemistry.

Lauer, Joan B., *Associate Professor of Psychology (1973); A.B., 1964, Ph.D., 1973, Indiana University.* Specialties: Clinical Psychology, Physiological Psychology, Learning.

Lees, Norman Douglas, *Chairperson and Associate Professor of Biology (1973); A.B., 1967, Providence College; Ph.D., 1973, Northwestern University.* Specialties: Microbiology, Molecular Biology.

Li, Xiaolin, *Assistant Professor of Computer and Information Science (1991); B.S., 1982, Wuhan University, People's Republic of China; M.S., 1985, M.Ph., 1986, Ph.D., 1987, Columbia University.* Specialty: Scientific Computing.

Lipkowitz, Kenneth B., *Professor of Chemistry (1976); B.S., 1972, State University of New York College at Geneseo; Ph.D., 1975, Montana State University.* Specialties: Theoretical and Synthetic Organic Chemistry.

Liu, Wei-min, *Assistant Professor of Mathematical Sciences (1987); B.S., 1968, Shanghai College of Mechanical and Electrical Engineering, People's Republic of China; M.S., 1981, Shanghai Institute of Biochemistry, People's Republic of China; M.S., 1986, Ph.D., 1987, Cornell University.* Specialties: Dynamical Systems Theory, Differential Equations, Biomathematics.

Long, Eric C., *Assistant Professor of Chemistry (1991); B.S., 1984, Albright College; Ph.D., 1989, University of Virginia.* Specialties: Biological Chemistry, Peptide and Metallopeptide-DNA Interactions.

Luke, Jon, *Associate Professor of Mathematical Sciences and Associate Professor of Computer and Information Science (1975); B.S., 1962, M.S., 1963, Massachusetts Institute of Technology; Ph.D., 1966, California Institute of Technology.* Specialty: Applied Mathematics.

Malik, David J., *Chairperson and Associate Professor of Chemistry (1980); B.S., 1968, M.S., 1969, California State University; Ph.D., 1976, University of California, San Diego.* Specialties: Theoretical Physical Chemistry, Chemical Physics.

McBride, Angela B., *Distinguished Professor and University Dean, School of Nursing, and Adjunct Professor of Psychology, School of Science (1980); B.S.N., 1962, Georgetown University; M.S.N., 1964, Yale University; Ph.D., 1978, Purdue University.* Specialties: Developmental Psychology, Psychiatric Mental Health.

McCracken, Richard O., *Associate Chairperson and Associate Professor of Biology (1977); B.S., 1965, M.S.T., 1967, University of Wisconsin–Whitewater; Ph.D., 1972, Iowa State University.* Specialty: Parasitology.

McGrew, John H., *Assistant Professor of Psychology (1991); B.M.E., 1977, GMI Engineering and Management Institute; M.S.E., 1977, University of Michigan; Ph.D., 1991, Indiana University.* Specialty: Health Psychology.

McIntyre, John A., *Adjunct Professor of Biology (1987); A.B., 1966, Rockford College; Ph.D., 1971, Wake Forest University.* Specialties: Immunology, Reproductive Biology.

Meiere, Forrest T., *Professor of Physics (1969); B.S. (Physics) and B.S. (Math), 1959, Carnegie-Mellon University; Ph.D., 1964, Massachusetts Institute of Technology.* Specialties: High Energy Physics, Biological Physics.

Metzner, Barbara S., *Adjunct Assistant Professor of Psychology (1986); A.B., 1962, M.S., 1964, Indiana University; B.A., 1979, Purdue University; Ed.D., 1983, Indiana University.* Specialty: Educational Research.

Miller, John Grier, *Associate Professor of Mathematical Sciences (1978, IUPUI Columbus); S.B., 1963, S.M., 1964, University of Chicago; Ph.D., 1967, Rice University.* Specialty: Geometric and Algebraic Topology.

Mirsky, Arthur, *Chairperson and Professor of Geology (1967); B.A., 1950, University of California, Los Angeles; M.S., 1955, University of Arizona; Ph.D., 1960, Ohio State University.* Specialties: Urban Geology, Environmental Geology, Geowriting, Evolution of the Earth.

Misiurewicz, Michal, *Professor of Mathematical Sciences (1992); M.A., 1971, Ph.D., 1974, Warsaw University, Poland.* Specialties: Dynamical Systems, Ergodic Theory.

Morrel, Bernard B., *Associate Professor of Mathematical Sciences (1977); B.A., 1962, M.A., 1966, Ph.D., 1968, University of Virginia.* Specialties: Operator Theory, Functional Analysis.

Morris, Barnett B., *Professor Emeritus of Psychology (1965); B.A., 1948, Brooklyn College; M.A., 1951, University of Nebraska; Ph.D., 1959, University of Oklahoma.* Specialties: Sensation, Perception, Statistics, Testing.

Muhoberac, Barry B., *Associate Professor of Chemistry (1985); B.S., 1972, Louisiana State University; Ph.D., 1978, University of Virginia.* Specialty: Biophysical Chemistry.

Murphy, James, *Associate Professor of Psychology (1989); B.A., 1971, Edinboro University of Pennsylvania; M.A., 1974, Ph.D., 1978, Bowling Green State University.* Specialties: Psychopharmacology and the Neurobiology of Behavior, Alcoholism and Drugs of Abuse.

Neel, Robert G., *Professor Emeritus of Psychology (1964); B.A., 1948, M.S., 1949, University of Denver; Ph.D., 1962, University of Michigan.* Specialties: Personnel and Industrial Psychology.

Ng, Bart, *Chairperson and Professor of Mathematical Sciences (1975); B.S., 1968, St. Joseph College; M.S., 1970, Ph.D., 1973, University of Chicago.* Specialty: Applied Mathematics.

Novak, Gregor M., *Associate Professor of Physics (1964); M.S., 1964, University of Chicago; Ph.D., 1975, Indiana University.* Specialties: Mathematical Physics, ICAI on Microcomputers.

Nurok, David, *Associate Professor of Chemistry (1978); B.Sc., 1959, Ph.D., 1966, University of Capetown, South Africa.* Specialties: Analytical Chemistry, Chromatography.

Ockerse, Ralph, *Professor of Biology (1976); B.A., 1956, State Teachers College, Netherlands; B.S., 1962, Baldwin-Wallace College; Ph.D., 1966, Yale University.* Specialties: Plant Physiology, Cellular Biochemistry.

O'Donnell, Martin J., *Professor of Chemistry (1975); B.S., 1968, University of Iowa; Ph.D., 1973, Yale University.* Specialty: Organic Chemistry.

Olson, Andrew M., *Associate Professor of Computer and Information Science (1984); B.S., 1959, University of Wyoming; M.S., 1961, University of Wisconsin; D.Sc., 1969, Washington University.* Specialties: Computational Mathematics, Symbolic-numeric Algorithms.

Ou, Zhe-Yu (Jeff), *Assistant Professor of Physics (1992), B.S., 1984, Beijing University, People's Republic of China; M.S., 1986, Ph.D., 1990, University of Rochester.* Specialties: Experimental Physics, Quantum Optics.

Pachut, Joseph F., Jr., *Associate Professor of Geology (1978), B.A., 1972, State University of New York College at Oneonta; Ph.D., 1977, Michigan State University.* Specialties: Invertebrate Paleontology, Paleoecology, Geobiology, Biometrics, Evolution of the Earth.

Paik, Han Won, *Associate Professor of Physics (1962); B.S., 1956, M.S., 1958, Yonsei University, South Korea; M.S., 1962, Northwestern University; Ph.D., 1970, Indiana University.* Specialty: High Energy Physics.

Palakal, Mathew J., *Assistant Professor of Computer and Information Science (1988); B. Comp. Sci., 1979, M. Comp. Sci., 1983, Ph.D., 1987, Concordia University, Canada.* Specialty: Artificial Intelligence, Speech Recognition, Pattern Recognition, Artificial Neural Networks.

Patterson, Richard R., *Associate Professor of Mathematical Sciences and Associate Professor of Computer and Information Science (1974); B.A., 1961, DePauw University; Ph.D., 1966, University of California, Berkeley.* Specialty: Geometric Modeling.

Pearlstein, Robert M., *Professor of Physics (1982); A.B., 1960, Harvard University; Ph.D., 1966, University of Maryland.* Specialties: Biological Physics, Statistical Mechanics.

Penna, Michael A., *Professor of Mathematical Sciences and of Computer and Information Science (1973); B.A., 1967, Union College; A.M., 1968, Ph.D., 1973, University of Illinois.* Specialty: Differential Geometry.

Petersen, Bruce H., *Adjunct Professor of Biology (1978); B.S., 1962, Utah State University; M.S., 1967, Ph.D., 1969, Indiana University.* Specialty: Immunology.

Pflanzer, Richard Gary, *Associate Professor of Biology, School of Science, and Associate Professor of Physiology and Biophysics, School of Medicine (1969); A.B., 1964, Ph.D., 1969, Indiana University.* Specialty: Medical Physiology.

Prezbindowski, Dennis R., *Adjunct Associate Professor of Geology (1991); B.S., 1973, Indiana University; M.S., 1974, Michigan State University; Ph.D., 1981, University of Texas at Austin.* Specialties: Environmental Geochemistry, Sedimentology, Hydrogeology.

Rajecki, D. W., *Associate Professor of Psychology (1980); B.A., 1968, Kent State University; Ph.D., 1972, University of Michigan.* Specialties: Aggression, Attitudes and Public Opinion, Animal Behavior.

Randall, Stephen K., *Assistant Professor of Biology (1990); B.S., 1976, University of Connecticut; Ph.D., 1982, Indiana University.* Specialties: Biochemistry, Cell Biology.

Rangazas, Sharon, *Lecturer in Mathematical Sciences (1989); B.S., 1984, M.A.T., 1987, Indiana University.* Specialty: Curriculum Development.

Rao, B. D. Nageswara, *Chairperson and Professor of Physics (1978); B.S., 1955, M.S., 1956, Andhra University, India; Ph.D., 1961, Aligarh Muslim University, India.* Specialties: Nuclear Magnetic Resonance, Biological Physics.

Rasmussen, Jeffrey L., *Associate Professor of Psychology (1984); B.A., 1979, University of Wisconsin; M.S., 1981, Ph.D., 1983, Tulane University.* Specialties: Quantitative Psychology, Computer Applications in Psychology.

Reid, William H., *Professor of Mathematical Sciences (1989); B.S., 1949, M.S., 1951, University of California, Berkeley; Ph.D., 1955, Sc.D., 1968, Cambridge University, U.K.* Specialty: Applied Mathematics.

Rigdon, Robert, *Associate Professor of Mathematical Sciences* (1975); A.B., 1965, Princeton; Ph.D., 1970, University of California, Berkeley. Specialty: Algebraic Topology.

Robinson, Bret A., *Adjunct Assistant Professor of Geology (1991); B.A., 1984, Indiana University; M.S., 1986, Ph.D., 1991, Southern Illinois University.* Specialties: Fluvial Geomorphology, Hydrogeology.

Rosenberg, Gary D., *Associate Professor of Geology (1979), B.S., 1966, University of Wisconsin; Ph.D., 1972, University of California, Los Angeles.* Specialties: Biomineralization, Evolution, Paleobiochemistry, Historical Geology.

Rothman, Neal J., *Professor of Mathematical Sciences (1982); B.S., 1951, University of Delaware; M.S., 1954, Tulane University; Ph.D., 1958, Louisiana State University.* Specialties: Functional Analysis, Harmonic Analysis.

Russo, Raymond J., *Associate Professor of Biology (1976); B.S., 1966, Southeast Missouri State University; M.S., 1971, Northeast Missouri State University; Ph.D., 1977, University of Notre Dame.* Specialties: Ecology, Population Dynamics of Medically Important Insects.

Rytting, Marvin, *Associate Professor of Psychology (1975, IUPUI Columbus); B.S., 1971, Brigham Young University; M.S., 1973, Ph.D., 1975, Purdue University.* Specialties: Personality, Social Psychology, Sociology of the Family.

Sarkar, Jyotirmoy, *Assistant Professor of Mathematical Sciences (1991); B.Stat., 1985, M.Stat., 1987, Indian Statistical Institute, India; Ph.D., 1990, University of Michigan.* Specialties: Mathematical and Applied Statistics, Applied Probability, Applied Mathematics.

Schoepp, Darryle D., *Adjunct Assistant Professor of Biology (1989); B.S., 1978, North Dakota State University; Ph.D., 1982, West Virginia University.* Specialty: Pharmacology.

Schultz, Franklin A., *Professor of Chemistry (1987); B.S., 1963, California Institute of Technology; Ph.D., 1967, University of California, Riverside.* Specialties: Analytical Chemistry, Electrochemistry.

Scriven, Eric, *Adjunct Professor of Chemistry (1983); B.S., 1965, University of Salford, U.K.; M.S., 1967, University of Guelph, Canada; Ph.D., 1969, University of East Anglia, U.K.* Specialty: Organic Chemistry.

Sen, Asok K., *Associate Professor of Mathematical Sciences (1981); B.S., 1972, Indian Institute of Technology, India; M.S., 1975, University of Minnesota; Ph.D., 1979, Cornell University.* Specialty: Applied Mathematics.

Sen, Stephanie, *Assistant Professor of Chemistry (1992); B.A., 1984, Bryn Mawr College; Ph.D., 1989, State University of New York at Stony Brook.* Specialties: Organic Chemistry, Biological Chemistry.

Seubert, James W., *Associate Professor of Physics (1968); A.B., 1958, Washington University; M.S., 1964, Ph.D., 1968, Indiana University.* Specialty: Nuclear Physics.

Shermis, Mark D., *Associate Professor of Psychology and Director of Testing, Planning, and Institutional Improvement (1992); B.A., 1975, University of Kansas; A.M., 1979, Ph.D., 1982, University of Michigan.* Specialty: Research Design and Evaluation.

Smith, Rosamund C., *Adjunct Assistant Professor of Biology (1991); B.A., 1979, Cambridge University, U.K.; Ph.D., 1983, Oxford University, U.K.* Specialty: Developmental Biology.

Stillwell, William H., *Associate Professor of Biology (1978), B.S., 1967, State University of New York at Albany; M.S., 1973, Ph.D., 1974, Pennsylvania State University.* Specialties: Biochemistry, Membranes, Origin of Life.

Stocum, David, *Dean of the School of Science and Professor of Biology (1989); B.A., 1961, Susquehanna University; Ph.D., 1968, University of Pennsylvania.* Specialty: Developmental and Cell Biology.

Sunderwirth, Stanley, *Professor of Chemistry (1988, IUPUI Columbus); B.A., 1951, Tarkio College; Ph.D., 1955, Ohio State University.* Specialties: General Chemistry, Organic Chemistry.

Svanum, Soren, *Associate Professor of Psychology, School of Science, and Adjunct Associate Professor of Clinical Psychology in Psychiatry, School of Medicine (1976); A.B., 1971, San Francisco State University; M.A., 1973, Ph.D., 1976, University of Montana.* Specialties: Clinical Psychology, Chemical Dependence, Health Care Psychology.

Tam, Richard Yiu Hang, *Associate Professor of Mathematical Sciences (1986); B.S., 1980, University of Alberta, Canada; M.Sc., 1982, Virginia Polytechnic Institute and State University; Ph.D., 1986, Cornell University.* Specialty: Applied Mathematics.

Tedesco, Lenore P., *Assistant Professor of Geology (1991); B.A., 1984, Boston University; Ph.D., 1991, University of Miami.* Specialties: Sedimentation, Marine Geology, Sedimentary Petrology, Carbonate Diagenesis.

Thatcher, Frederick C., *Associate Professor of Physics (1970); B.S., 1961, University of Chicago; M.S., 1964, DePaul University; Ph.D., 1969, University of California, Riverside.* Specialties: Condensed Matter Physics, Applied Optics.

Trexler, Lance E., *Adjunct Assistant Professor of Psychology (1990); B.A. 1974, Indiana University; M.S., 1976, Ball State University; Ph.D., 1979, Purdue University.* Specialty: Neuropsychology.

Tzeng, Oliver C. S., *Professor of Psychology (1976); B.Ed., 1966, National Taiwan Normal University, Republic of China; M.S., 1969, University of Wisconsin–Stout; Ph.D., 1972, University of Illinois.* Specialties: Quantitative Psychology; Cross-Cultural Social Psychology, Personality.

Vasavada, K. V., *Professor of Physics (1970); B.S., 1958, University of Baroda, India.; M.S., 1960, University of Delhi, India; Ph.D., 1964, University of Maryland.* Specialties: High Energy Physics, Biological Physics.

Vemuri, Gautam, *Assistant Professor of Physics (1992); B.Sc., 1984, Delhi University, India; M.S., 1986, Brown University; Ph.D., 1990, Georgia Institute of Technology.* Specialties: Laser Physics, Nonlinear Optics.

Wagner, Patrick A., *Adjunct Assistant Professor of Psychology (1992); A.B., 1969, M.S., 1971, Ph.D., 1976, Indiana University.* Specialty: Rehabilitation Counseling.

Wang, Qi, *Assistant Professor of Mathematical Sciences (1991); B.S., 1982, Nankai University, People's Republic of China; M.S., 1988, Ph.D., 1991, Ohio State University.* Specialties: Computational Mathematics, Non-Newtonian Fluid Dynamics, Nonlinear Differential Equations.

Ware, Joseph Roger, *Associate Professor of Psychology (1972); B.S., 1957, M.S., 1961, University of Louisville; Ph.D., 1972, University of Kentucky.* Specialties: Humanistic Psychology, Group Dynamics, Psychological Type.

Wassall, Stephen R., *Associate Professor of Physics (1984); B.Sc., 1973, Southampton University, U.K.; Ph.D., 1981, Nottingham University, U.K.* Specialties: Nuclear Magnetic Resonance, Biological Physics.

Watt, Jeffrey X., *Assistant Professor of Mathematical Sciences (1988); B.S., 1983, Michigan Technological University; M.S., 1985, Purdue University; Ph.D., 1990, Indiana University.* Specialties: Curriculum and Instruction of Mathematics, Educational Statistics, Assessment.

Welcher, Frank J., *Professor Emeritus of Chemistry (1935); A.B., 1929, M.A., 1930, Ph.D., 1932, Indiana University.* Specialties: Analytical Chemistry and General Chemistry.

Wilson, Kathryn J., *Associate Dean for Research and Faculty Development, School of Science, and Associate Professor of Biology (1976); B.A., 1971, University of Wisconsin–Madison; M.A., 1976, Ph.D., 1976, Indiana University.* Specialties: Plant Developmental Anatomy and Morphology, Electron Microscopy.

Witzmann, Frank A., *Professor of Biology (1985, IUPUI Columbus); B.A., 1976, Defiance College; M.S., 1978, Ball State University; Ph.D., 1981, Marquette University.* Specialty: Muscle Physiology.

Wojciechowski, Krzysztof P., *Assistant Professor of Mathematical Sciences (1989); M.S., 1977, Poznan University, Poland; Ph.D., 1982, Mathematical Institute of Polish Academy of Science, Poland.* Specialty: Global Analysis.

Wu, Jian, *Assistant Professor of Computer and Information Science (1989); B.S., 1982, Peking University, People's Republic of China; M.S., Ph.D., 1987, Harvard University.* Specialties: Computer Vision, Robotics.

Wyma, Richard J., *Associate Professor of Chemistry (1969); A.B., 1958, Hope College; M.S., 1960, Ph.D., 1964, University of Michigan.* Specialties: General Chemistry, Physical Chemistry.

Yan, Keren, *Assistant Professor of Mathematical Sciences (1989); B.S., 1982, M.S., 1985, Ph.D., 1987, Fudan University, People's Republic of China.* Specialty: Operator Theory.

Yovits, Marshall C., *Professor of Computer and Information Science and Dean Emeritus, School of Science (1980); B.S., 1944, M.S., 1948, Union College; M.S., 1950, Ph.D., 1951, Yale University.* Specialty: Computer and Information Science.

Zeldin, Martel, *Professor of Chemistry (1981); B.S., 1959, Queens College; M.A., 1962, City University of New York; Ph.D., 1966, Pennsylvania State University.* Specialties: Inorganic Chemistry, Organometallic Chemistry, Polymer Chemistry.

Ziemian, Krystyna, *Assistant Professor of Mathematical Sciences (1992); M.S., 1977, Ph.D., 1985, Warsaw University, Poland.* Specialties: Dynamical Systems, Ergodic Theory.

Zuckerman, Steven H., *Adjunct Assistant Professor of Biology (1988); B.S., 1973, New York University; Ph.D., 1977, University of Minnesota.* Specialty: Immunology.

Degree Checklist for School of Science Bachelor of Arts Degree

The School of Science requirements are listed. For all areas, see appropriate sections of the bulletin for additional requirements or restrictions by the school or the departments.

Area I English Composition and Communicative Skills Two courses in composition totaling 6 credit hours. One course in speech of 3 credit hours.

Composition _____ Speech _____

_____

Area II Foreign Language No courses required by the school.

_____ _____

Area IIIA Arts and Humanities Four courses totaling at least 12 credit hours.[1]

_____ _____

_____ _____

Area IIIB Social and Behavioral Sciences Four courses totaling at least 12 credit hours.[1]

_____ _____

_____ _____

Area IIIC Physical and Biological Sciences At least four science courses totaling a minimum of 12 credit hours outside the major department. (At least one of these must be a laboratory course.)[2]

_____ _____

_____ _____

Area IIID Mathematical Sciences One course in computer science and one course in mathematics.[3]

_____ _____

Area IV Major Consult departmental listing for courses required in the major as well as courses required in other areas by the department.

_____ _____ _____

_____ _____ _____

_____ _____ _____

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[1]There must be at least two courses in one discipline in either IIIA or IIIB.
[2]Courses not acceptable for IIIC include BIOL N100, BIOL N120, BIOL N200, GEOL G130, all agriculture courses, and CHEM C100.
[3]Mathematics courses not acceptable for any degree program in the School of Science include MATH 001, 002, 111, 123, 130, 131, and 132.

Degree Checklist for School of Science Bachelor of Science Degree

The School of Science requirements are listed. For all areas, see appropriate sections of the bulletin for additional requirements or restrictions by the school or the departments.

Area I English Composition and Communicative Skills Two courses in composition totaling 6 credit hours. One course in speech of 3 credit hours.

Composition _____ Speech _____

_____

Area II Foreign Language No courses required by the school.

_____ _____

Area IIIA Arts and Humanities Two courses totaling at least 6 credit hours.[1]

_____ _____

Area IIIB Social and Behavioral Sciences Two courses totaling at least 6 credit hours.[1]

_____ _____

Area IIIC Physical and Biological Sciences At least four science courses totaling a minimum of 12 credit hours outside the major department. (At least one of these must be a laboratory course.)[2]

_____ _____

_____ _____

Area IIID Mathematical Sciences At least two courses beyond algebra and trigonometry, totaling a minimum of 6 credit hours. One course in computer science.

_____ _____

_____ _____

Area IV Major Consult departmental listing for courses required in the major as well as courses required in other areas by the department.

_____ _____ _____

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_____ _____ _____

[1]There must be two courses in one discipline in either IIIA or IIIB.
[2]Courses not acceptable for IIIC include BIOL N100, BIOL N120, BIOL N200, GEOL 130, all agriculture courses, and CHEM C100.

Index

Key to Course Codes

AGR	Agriculture
AGRY	Agronomy
ANAT	Anatomy
AST	Astronomy
BIOL	Biology
BUS	Business
CHEM	Chemistry
COMM	Communication and Theatre
CPT	Computer Technology
CSCI	Computer Science
EDUC	Education
EE	Electrical Engineering
ENG	English
FN	Food and Nutrition
GEOG	Geography
GEOL	Geology
GEOS	Geoscience
HPER	Physical Education
MATH	Mathematics
PHSL	Physiology
PHYS	Physics
PSY	Psychology
SPEA	Public and Environmental Affairs
STAT	Statistics
TCM	Technical Communications

Useful Addresses

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Associate Dean for Academic Programs and Student Development
Mary Ellen Alig
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Kim Nguyen
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