

# College of Natural Sciences and Mathematics

Undergraduate Catalog 2017-2018

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### **Mission Statement**

The Faculty of The University of Toledo's College of Natural Sciences and Mathematics seek to build and disseminate foundational and applicable knowledge through excellence in teaching, research and discovery, and community engagement; foster the advancement of science, mathematics and technology locally, regionally, and globally; and serve as a transformative force within a diverse, interdisciplinary, and collaborative education environment for improving our world through science and mathematics.

### **Admission Policies**

New first-year students must (1) submit a college test score (ACT or SAT) and (2) have either a 2.5 high school GPA or ACT composite of 20 (SAT combined reading and math score of 950 if taken before March 2016, new SAT score of 1030 if taken March 2016 or after) to be admitted to the College of Natural Sciences and Mathematics. Applicants not meeting these standards will be admitted to the Department of Exploratory Studies in the University College. Students applying who want to be admitted as BS Biology degree program in the Department of Biological Sciences must have a minimum high school GPA of 2.75. Students not meeting this requirement but meeting the minimum college requirements will be admitted to the BA Biology degree program.

To be considered for admission to the pre-medical, pre-dental and pre-veterinary programs, students will need a minimum high school cumulative GPA of 3.2 and an ACT composite score of 25 (or minimum SAT combined reading and math score of 1150 if taken before March 2016, new SAT score of 1220 if taken March 2016 or after). Students should also have successfully completed a minimum of three years of high school mathematics (algebra I, algebra II and geometry) and high school chemistry. Applicants not meeting these standards but meeting the Natural Sciences and Mathematics college admission standards will be admitted to the College of Natural Sciences and Mathematics degree program of their choice or as BS-UND (undeclared).

### **Change of College**

Students in good standing (i.e. with a cumulative UT GPA of 2.0 or higher) who wish to change from another college of The University of Toledo to the College of Natural Sciences and Mathematics should make an appointment with a college adviser in the College Student Services Office to discuss their transfer and have their academic records reviewed. All college requirements, including core, skill area, distributive, major and related requirements, must be fulfilled as specified in the catalog for the year in which the student enters the College of Natural Sciences and Mathematics. Credit restrictions and level requirements for Natural Sciences and Mathematics students will apply. Continuing UT students seeking admission to pre-medical, pre-dental and pre-veterinary programs must have a 3.0 cumulative college GPA and have completed CHEM 1090 or 1230 and MATH 1320 or higher with a B or better.

### **Change of Catalog Year**

Continuing students who declared a major within the College of Natural Sciences and Mathematics prior to Fall 2012 may change to the current catalog year. Interested students should visit the Student Services Office (UH 3000) and meet with their academic adviser to officially declare their new catalog year.

### **Admission with Transfer Credit from Another Institution**

No more than 94 semester hours of credit earned at other institutions may apply toward a degree in the College of Natural Sciences and Mathematics. Course work from other institutions is accepted at the level the equivalent course is taught at The University of Toledo. Students with transfer credit are generally expected to fulfill all University and College course requirements for a degree in the College of Natural Sciences and Mathematics as specified in the catalog for the year in which they enter the College of Natural Sciences and Mathematics. In some cases, not all the credits that transfer into The University of Toledo will apply toward a degree in the College of Natural Sciences and Mathematics, e.g., developmental courses. Transfers from other institutions shall take at least 30 semester hours at The University of Toledo, including 12 semester hours of work in their major field and 9 semester hours in their minor field, regardless of the number of hours transferred.

Students transferring to the University of Toledo in Spring 2007 or later, including transfer readmits, must meet minimum GPA requirements in their Natural Sciences and Mathematics majors and minors with both (1) the grades of all courses attempted at UT and (2) in a second calculation, the grades of all courses attempted at all institutions (including UT). The grades of all courses (from all institutions) which are used by those students to satisfy UT Core requirements must be used in the calculation of the UT General Education GPA.

UT students who attend other institutions as guests or transient students must also meet minimum GPA requirements in their Natural Sciences and Mathematics majors and minors with (1) the grades of all courses attempted at UT and (2) in a second calculation, the grades of all courses attempted at all institutions (including UT). The grades of all courses (from all institutions) which are used by those students to satisfy UT Core requirements must be used in the calculation of the UT General Education GPA.

For the purposes of meeting minimum cumulative GPA's in a student's Natural Sciences and Mathematics major(s) and/or minor(s) and the UT Core, the grades of all courses attempted at all institutions will be included in the GPA calculation(s). Note: Due to technological limitations of UT's current Degree Audit Reporting System, Degree Audit GPA calculations for students who have taken courses at other institutions may not be accurate. Consult a college staff adviser if you have questions.

Transfer students should note that The University of Toledo will include all course work taken at all institutions of higher education in the calculation to determine if a student will graduate with honors. All college course work ever taken is computed in determining eligibility for graduation with honors, although no student will be awarded a level of honors above that indicated by The

University of Toledo cumulative grade point average (GPA). Note: The University of Toledo requires a minimum of 30 semester hours of standard letter graded courses from UT in order to qualify for graduation with honors.

An applicant who has undertaken courses at a regionally accredited college or university and who submits through the Office of Undergraduate Admission for Adult, Transfer and International Students an official transcript listing courses and grades and giving evidence of good standing will be admitted to the College of Natural Sciences and Mathematics, provided the student has maintained a minimum GPA of 2.0 on a 4.0 scale.

Exceptions to this minimum admission requirement are rarely made and require the applicant to demonstrate, in a written petition to the committee on academic standing, that there are special circumstances that warrant waiver of the requirement. Approval of the petition is not automatic, and those students who are admitted by petition will be placed on special probationary status and must meet certain conditions to remain enrolled.

If the college from which the applicant transfers lacks proper accreditation, the student may be denied transfer credit on the basis of the transcript, but may be allowed to obtain credit by passing advanced standing examinations with at least a C grade. Official transcripts of records from all schools previously attended must be on file with the Office of Undergraduate Admission for Adult, Transfer and International Students before the student will be permitted to register.

### **A Second Degree at The University of Toledo**

#### *A Second Degree within the College of Natural Sciences and Mathematics:*

A student earning a degree at The University of Toledo in the College of Natural Sciences and Mathematics may simultaneously earn a second degree in a different department within the College of Natural Sciences and Mathematics (NSM) by completing the requirements of both degrees. General education courses that meet the requirements of both degrees will count for both. The two degrees must be of a different type (e.g. – BS and BA) and both must be offered by NSM. A student who has previously earned a BA degree in the College of Natural Sciences and Mathematics may return to complete a BS degree in the same major by fulfilling the major and related field requirements for the BS degree as described in the catalog for the year of readmission. A student who previously earned either a BA or BS degree in the College of Natural Sciences and Mathematics may return to complete either a BA or BS in a different department by fulfilling the NSM college, major and related field requirements for the degree and major desired, as described in the catalog for the year of readmission. University and NSM college general education courses that meet the requirements of both degrees will count for both. Courses in the Related Area of the first major may count towards the second major unless other related courses are required.

#### *A Second Major within a Bachelor of Science or Bachelor of Arts degree in the College of Natural Sciences and Mathematics:*

A student earning a Bachelor of Science or a Bachelor of Arts in the College of Natural Sciences and Mathematics may simultaneously earn a second major in a different department by completing the requirements of both majors as specified for the same degree program (BA or BS). Courses in the Related Area of the first major may count towards the second major unless other related courses are required. It is important to understand that completing this pathway will result in the achievement of a single degree, but with dual majors, from the College of Natural Sciences and Mathematics. All requirements for both majors must be completed in the same graduation term.

#### *A Second Degree in the College of Natural Sciences and Mathematics at The University of Toledo:*

A student earning a degree in another College at The University of Toledo may earn a second degree simultaneously in the College of Natural Sciences and Mathematics through the completion of all requirements of both degrees. A student who previously earned a degree in another College at the University of Toledo [or elsewhere] may earn a second degree in the College of Natural Sciences and Mathematics through the completion of all requirements of the College of Natural Sciences and Mathematics degree. General education courses that meet the requirements of both degrees will count for both.

Important Note: Courses constituting a departmental or interdisciplinary major may not also be used to meet requirements for a different departmental or interdisciplinary major either within or outside the College of Natural Sciences and Mathematics. Courses constituting a departmental or interdisciplinary minor may be used to meet requirements for a different departmental or interdisciplinary minor with restrictions (please refer to “Minors” parameters outlined in letter J within “Degree Requirements” below).

### **Requirements for Students with an Associate’s Degree**

Students holding an Associate of arts or Associate of science degree from an accredited college are encouraged to enroll in the College of Natural Sciences and Mathematics and, in many instances, may expect to earn an appropriate baccalaureate upon completion of two years of full-time study. Students with an Associate’s degree in a technical program will likely require more time to complete a bachelor’s degree. The following regulations apply:

- Students must complete the equivalent of the specified University and college core and distributive requirements for a bachelor’s degree.
- In all baccalaureate programs, a minimum of 64 hours must be taken at the 2000 to 4000 levels; of these, a minimum of 32 hours must be taken at the 3000 to 4000 levels in baccalaureate degree - granting colleges. Course work from other institutions is accepted at the level the equivalent course is taught at The University of Toledo.
- Students may enroll in any departmental, interdepartmental or interdisciplinary program for which they meet the admission criteria. All of the usual major and related area requirements must be fulfilled as specified in the catalog for the year in which the student entered the College of Natural Sciences and Mathematics.

### **Readmission of Former Arts and Sciences or Natural Sciences and Mathematics Students**

Students who have withdrawn from the former College of Arts and Sciences or the College of Natural Sciences and Mathematics and The University of Toledo and have not attended any other institution in the Interim may be readmitted, provided they were eligible to continue enrollment in the college at the time they discontinued attendance. Such students should readmit at the College Student Services Office. Students who have been suspended from the College of Natural Sciences and Mathematics must submit a written letter of petition. Students who readmit after more than 12 consecutive months’ absence must comply with existing college requirements at the time of readmission.

### **Academic Policies**

Refer to [UT Policy website](#) for academic policies that apply to all students.

### **Academic Advising**

Academic advising is a process intended to help students derive as many benefits as possible from their educations. This occurs when advisers help students develop and reach academic and career goals. While the ultimate responsibility for making personal and educational decisions rests with the student, advisers assist by helping to identify and assess alternatives and the consequences of decisions. Advising can be much more than selecting courses. The more frequently students arrange to meet with their advisers, the better their needs can be served. New students, transfer students, students changing colleges, and continuing general studies students are advised in the College of Natural Sciences and Mathematics Student Services Office, University Hall Room 3000, by college staff advisers. See the [Student Services](#) web page for more information. They provide essential information; help students select courses to meet University General Education and college skill area and distributive

requirements; suggest courses for the exploration of majors and minors; and help students evaluate academic progress and adjustment to university life. Students with declared majors and/or minors are advised by departmental major or program advisers, faculty who provide general information as well as more specialized information about majors and minor programs, departmental course offerings, and career and graduate opportunities. They help students select courses for general, major, related, and other requirements. Students in the Honors College and those seeking more than one major or degree, a minor, or admission to professional school should meet periodically with one or more additional Advisers. A complete list of academic advisers is available on the college website or in the College office.

### **Student Responsibilities**

Students are responsible for correctly selecting courses for their programs of study each semester and for fulfilling all degree requirements. Although advisers will assist wherever possible, the final responsibility rests with the student. Students are expected to make sure that they are fulfilling all degree requirements, as published in the issue of the catalog of the College of Natural Sciences and Mathematics under which they entered. Students who have been out of the College of Natural Sciences and Mathematics for 12 consecutive months are responsible for the requirements in the University catalog under which they reenter.

### **Transcripts and Degree Audit Reports**

A transcript is a complete chronological list of a student's academic course work (including all courses attempted and grades earned). It does not show how specific courses apply or do not apply to University and college requirements as stipulated in this catalog. For example, developmental, non-repeatable and certain other courses are not counted toward minimum credits for degrees, but appear on transcripts. The Degree Audit Report (DAR) details all requirements applicable to a student's academic program (degree, major, minor) and applies the student's courses on the transcript (including transfer credit) to those requirements. The DAR should be used to identify requirements remaining when all registered courses are completed. The College of Natural Sciences and Mathematics Student Services Office (UH Room 3000) will provide an unofficial transcript and DAR to a College of Natural Sciences and Mathematics student presenting a picture ID. Students also may view their transcript and DAR through the [myUT](#) portal with Student Self-Service.

### **Declaring or Changing a Major or Minor**

To declare a major or minor or change one previously declared, students must fill out a form that is available in the College Student Services Office (UH Room 3000).

### **Sequence of Courses**

There is no single prescribed sequence of courses, except that all first-year students should take NSM 1000 Orientation, and any developmental courses required on the basis of placement testing and/or high school deficiencies. Students should consult the later sections of the catalog devoted to programs of study and course offerings, and they should review their programs with their academic advisers to ensure they complete courses in the proper sequences. In addition, students should use their Degree Audit Reports to track their progress.

Entering students majoring in mathematics or in one of the areas of the natural sciences usually should begin the special courses designated as prerequisite for advanced courses in their first year. For example, calculus is a prerequisite for other mathematics courses and for later courses in physics, chemistry and geology. General Chemistry I and II, the Biology Fundamentals of Life Science sequence, and Fundamentals of Geology are prerequisites for succeeding courses required for majors in these areas.

## **Study Abroad**

Students who plan to study abroad must be sure that their proposed course of study is properly accredited. Its academic acceptability should be verified by the college before departure. Students also should ascertain in advance from their advisers whether the course work will count toward their general requirements, majors, or related areas or only be regarded as elective. Credit for foreign language study is subject to the approval and recommendation of the department of foreign languages. Information about study abroad programs is generally available from Advisers in many college programs and departments and from the [Center for International Studies and Programs \(Education Abroad Office\)](#).

## **Transient (Guest) Enrollment at Another Institution**

College of Natural Sciences and Mathematics students must have advance permission both to enroll elsewhere as a guest and to take specific courses. The Transient Student form for this purpose is available in the College Student Services Office and on the college website. Students enrolling without permission will be considered transfer readmits upon their return to UT. Natural Sciences and Mathematics students enrolled as transients or guests at another institution must submit an official transcript to the UT Office of Admission at the conclusion of the enrolled term. Grades of all courses attempted in the major, minor, and UT Core will be used in cumulative GPA calculations.

## **GPA Recalculation for Repeated Courses**

The College of Natural Sciences and Mathematics permits a maximum of 12 semester hours or the equivalent of 16 quarter hours of course work to be deleted from the GPA calculation. Students who have had their GPAs recomputed under the Academic Forgiveness Policy are not eligible for grade deletions. Criteria governing this policy are given in the Undergraduate Policy 3364-71-05: GPA Recalculation: [http://www.utoledo.edu/policies/academic/undergraduate/pdfs/3364-71-05\\_Academic\\_grievance.pdf](http://www.utoledo.edu/policies/academic/undergraduate/pdfs/3364-71-05_Academic_grievance.pdf). Students should check with the College Student Services Office for more specific information on this policy. Students may not use repeat courses taken at other institutions to qualify for a GPA recalculation.

## **Withdrawal Policy (W, IW, DR Grades)**

The number of credit hours of W, IW and DR is limited to 22 hours for all undergraduate students in degree programs in the College of Natural Sciences and Mathematics. Once a student has accumulated 22 hours of W, IW or DR, further withdrawals will be counted as F's in computation of the student's GPA for purposes of probation or suspension. In addition, students who receive financial aid risk the loss of financial aid if they accumulate excessive hours of W, IW and DR. Students who transfer into the College of Natural Sciences and Mathematics from another college at The University of Toledo will bring with them the number of W's, IW's and DR's accumulated in their previous work.

**Note:** Assignment of the IW and DR grades has been discontinued. A student wanting to be withdrawn from a course must file a petition in the Records Office by the deadline in the term of enrollment.

## **Academic Probation**

A student whose cumulative GPA is less than 2.0 is automatically placed on probation until a 2.0 cumulative GPA is achieved (See Withdrawal Policy above). It is recommended that a student on probation not enroll for more than 12 to 14 credits.

## **Academic Suspension**

Academic suspension means that a student is prohibited from registering at The University of Toledo for a period of at least one semester. Students are subject to academic suspension if their GPA falls below the minimum GPA listed below or if they fail to make sufficient progress toward attainment of the degree. (See Withdrawal Policy). Students may remove Incompletes while under suspension. A student is subject to academic suspension if the cumulative GPA is less than: 1.0 for 10 to 19 hours attempted; 1.5 for 20 to 29 hours attempted; 1.7 for 30 to 39

hours attempted; 1.8 for 40 to 49 hours attempted; 1.9 for 50 to 59 hours attempted; less than 2.0 for 60 or more hours attempted. After accumulating 60 credit hours without suspension, a student may be suspended if the cumulative GPA falls below 2.0 for two consecutive semesters.

### **Trial Readmission Policy**

After the required suspension period, a student may petition for readmission to the College of Natural Sciences and Mathematics to the Director of the Student Services Office. The petition must be received by the posted deadline on the Student Services reinstatement [website](#). If the petition is accepted, the college committee will determine the terms of the conditional registration agreement, under which the student will be permitted to re-enroll. Suspended students who are granted readmission must maintain the designated GPA for each semester thereafter and meet the conditions of their readmission agreement. Students failing to meet these conditions are subject to a one-year suspension. Full details including procedures, deadlines, and how to file a petition for reinstatement can be found on the Student Services website (<https://www.utoledo.edu/offices/student-services/reinstatementpolicy1.html>)

### **Dismissal Policy**

Students who fail to meet the conditions for readmission after their second suspension are subject to dismissal and are not eligible for readmission to the College of Natural Sciences and Mathematics for at least three years. *Criteria governing this policy are detailed in the undergraduate policy 3365-71-06: Academic Forgiveness:* <http://www.utoledo.edu/policies/academic/undergraduate/pdfs/3364-71-06%20%20Academic%20forgiveness.pdf>.

### **Academic Grievance**

A student has the responsibility and right to call to the attention of an instructor any grade that the student believes to be in error or unfair. A student may appeal the decision of the instructor, in order, to the department Chair, the Dean, then to the college appeals committee if the problem is not resolved. If the problem is not resolved at the college level, the student may appeal to the student grievance council (*See also The University of Toledo Student Handbook:* <http://www.utoledo.edu/studentaffairs/pdfs/studenthandbook.pdf>). A student must begin the appeals process no later than the last day of classes of the semester (excluding summers) following the one in which the grievance arose.

### **Statement on Academic Dishonesty**

A student found to be academically dishonest by a faculty member may appeal, in order, to the department Chair, the Dean, the college appeals committee and the University student grievance council. The procedures for making an appeal to the student grievance council may be found in The University of Toledo Student Handbook: <http://www.utoledo.edu/studentaffairs/pdfs/studenthandbook.pdf>. Criteria governing this policy are detailed in undergraduate policy 3364-71-04: Academic Dishonesty: <http://www.utoledo.edu/policies/academic/undergraduate/pdfs/3364-71-04%20%20Academic%20dishonesty.pdf>.

### **College Level Examination Program (CLEP)**

The College of Natural Sciences and Mathematics will accept a maximum of 21 semester hours of CLEP through successful completion of the four general examinations. Additional credit may be earned through satisfactory scores on individual subject examinations. Required minimum scores and credits awarded are as follows:



## General Examinations

**Humanities:** For a score of 50, a student will receive six hours credit in the humanities.

**College mathematics:** For a score of 65, a student will receive three hours credit for MATH 1180.

**Natural sciences:** For a score of 50, a student will receive six hours credit in the natural sciences.

**Social sciences and history:** For a score of 50, a student will receive six hours credit in the social sciences.

## Subject Examinations

**American government:** For a score of 50, a student will receive three hours credit for PSC 1200.

**Biology:** For a score of 50, a student will receive three hours credit for BIOL 1120.

**Calculus:** For a score of 65, a student will receive four hours credit for MATH 1850.

**Chemistry:** For a score of 50, a student will receive eight hours credit for CHEM 1230 and CHEM 1240.

**College algebra:** For a score of 65, a student will receive three hours credit for MATH 1320.

**College algebra – Trigonometry:** For a score of 65, a student will receive four hours credit for MATH 1340.

**French language:** For a score of 50, a student will receive four hours credit for FREN 1500. For a score of 62, a student will receive seven hours credit for FREN 1500 and FREN 2140.

**German language:** For a score of 50, a student will receive four hours credit for GERM 1500. For a score of 62, a student will receive seven hours credit for GERM 1500 and GERM 2140.

**Spanish language:** For a score of 50, a student will receive four hours credit for SPAN 1500. For a score of 66, a student will receive seven hours of credit for SPAN 1500 and SPAN 2140.

**Trigonometry:** For a score of 65, a student will receive three hours credit for MATH 1330.

## Advanced Placement Program

Refer to the University of Toledo Registrar's web page

([http://www.utoledo.edu/offices/registrar/student\\_records/advan\\_credits.html](http://www.utoledo.edu/offices/registrar/student_records/advan_credits.html)) for specific information on minimum scores and credits awarded for Advanced Placement examinations administered by the College Board Advanced Placement Program.

## Pass/No Credit Option

Students may elect to enroll in certain undergraduate courses for Pass/No Credit rather than an A-F grade. Students must complete a petition to take a class Pass/No Credit and obtain the approval of their college before the end of the 15<sup>th</sup> calendar day of the term. Grades of C or better will be changed to PS, and grades of C-, D+, D, D-, and F will be changed to NC. The grades of PS and NC do not affect the grade point average. Refer to programs of study in the College of Natural Sciences and Mathematics section of this catalog for the limitations on pass/no credit grading in effect for different majors. Undeclared students, as a general rule, should not elect pass/no credit grading in major-level courses.

## Graduation Evaluation Requirement

Two or three semesters (at 80 earned credit hours) before a student intends to graduate, the student and the student's major adviser should complete a Graduation Quick Check Form. This process is initiated by the student. Students with more than one major or one or more minors must be evaluated for the completion of each major and minor. Detailed instructions on the Graduation Quick Check Form and graduation procedures are available at the Student Services office (UH 3000).

## Field Experience/Internship

Policies and procedures for incorporating field experiences or internships in academic programs vary from major to major. Some majors require a field experience or internship; for other majors, they are optional. Students should seek information from their major departments and obtain advance approval for all field experiences or internships.

## **Degree Requirements**

The College of Natural Sciences and Mathematics offers both Bachelor of Arts and Bachelor of Science degrees. Requirements differ based on degree as indicated below.

### **A. Grade Point Averages**

A cumulative grade point average (GPA) reflects all grades earned, including grades of F and grades in repeated courses. Candidates must earn a minimum overall cumulative GPA of C (that is, a 2.0 GPA on a 4.0 scale) for all UT course work. In addition, candidates must earn a minimum cumulative GPA of C in the major, minors (optional) and UT General Education, with the grades of all courses attempted at all institutions included in the GPA calculation. Some programs require a higher GPA in the major. For example, BS Chemistry, BS Biochemistry, and BS Geology require a 2.5 GPA. *Criteria governing this policy are given in the Undergraduate Policy 3364-71-07: GPA*

Recalculation: [http://www.utoledo.edu/policies/academic/undergraduate/pdfs/3364-71-07\\_Repeating\\_a\\_course\\_and\\_recalculation\\_of\\_GPA.pdf](http://www.utoledo.edu/policies/academic/undergraduate/pdfs/3364-71-07_Repeating_a_course_and_recalculation_of_GPA.pdf).

### **B. Residency Requirement**

Students transferring from other institutions must earn at least 30 hours of credit at The University of Toledo; at least 12 of these must be in the major area, and for students pursuing a minor, at least 9 hours must be earned at The University of Toledo. Full-time students must take their last semester, and part-time students their last 12 hours, in residence, unless alternative arrangements have been made in advance with the Dean of the College of Natural Sciences and Mathematics.

### **C. Credit Hours and Levels**

1. Students must complete a minimum of 124 hours of course work that must include the University General Education and college skill area and distributive requirements, and either major and course work related to the major, or an interdisciplinary program.
2. In all baccalaureate programs, a minimum of 64 hours must be taken at the 2000 to 4000 levels; of these a minimum of 32 hours must be taken at the 3000 to 4000 levels.
3. Students are cautioned to make use of their degree audit and review remaining requirements with their adviser before every registration in order to make progress toward completion of their requirements in an orderly, timely manner. Insofar as a student can complete the basic courses and the courses required for a chosen major (as outlined in sections E - J below) in fewer than the 124 hours required for a degree, the student must choose elective courses to complete the total of 124 hours, subject to the restrictions outlined below.

### **D. Credit Restrictions**

Total earned hours shown on a student's transcript may not all be applicable to the minimum 124 credits required for a degree, as follows:

1. Students with entrance deficiencies in mathematics and other students who are required or choose to take developmental course work will need to complete additional hours.
2. No courses in typing, shorthand or keyboarding will apply toward the degree.
3. No more than two hours in skill courses in physical education or recreation courses at the 1000 level will apply toward the degree.
4. No more than two hours in Student Leadership Development I and II will apply toward the degree.
5. Duplicate credit – except for courses identified as repeatable courses, students will not receive credit for repeated courses (taking the same course twice), whether taken at The University of Toledo or elsewhere.

6. The college reserves the right to deny credit for other specific courses (including most SKLS courses) and for blanket technical credit not applicable to a student's specific program.

### **E. University General Education Requirements**

Students earning baccalaureates in all colleges and programs are required to complete between 33-34 credit hours of courses that comprise the General Education Curriculum. Those courses are distributed in the areas of English composition, humanities/fine arts, social sciences, natural sciences and mathematics, and multicultural studies courses. Students should view their Degree Audit Report or contact their academic department or college office for specific details.

### **F. Natural Sciences and Mathematics Skill Area Requirements**

Students are placed into mathematics courses by ACT scores or placement tests in those subjects. Students are placed into foreign language courses through placement testing.

#### **1. Orientation (NSM1000) - 2 hours**

All new first-year students are required to take NSM1000. The course is optional for transfer students.

**2. English Composition** (University of Toledo General Education and College of Natural Sciences and Mathematics requirement) – 6 hours. To earn a degree in the College of Natural Sciences and Mathematics, students must pass both Composition I and II with a C or better. (Students in the Honors College must pass HON 1010 and 1020 with a C or better to meet the Composition I and II requirements.) The College of Natural Sciences and Mathematics recommends that these requirements be met before completing 45 credit hours.

a. Native speakers track (for students for whom English is a first language).

**ENGL 1110 – 3 hours** College Composition I

**ENGL 1130, 1140, 1150, 2950, or 2960 – 3 hours** College Composition II

b. Non-native speakers track (for students for whom English is a second language). Students will take an English placement test to determine appropriate starting level.

**ENGL 1020 – 3 hours** Writing and Grammar for English as a Second Language

**ENGL 1110 – 3 hours** College Composition I

**ENGL 1130, 1140, 1150, 2950, or 2960 – 3 hours** College Composition II

**3. Mathematics** (UT General Education and College of Natural Sciences and Mathematics requirement) – 3-8 hours.

a. Bachelor of Arts (BA)

**MATH1320** College Algebra or **MATH1340** College Algebra and Trigonometry or

**MATH2600** Intro to Statistics or **MATH2640** Statistics for Applied Science or higher Math.

b. Bachelor of Science (BS)

Two semesters of Calculus (**MATH1750** and **MATH1760** or **MATH1830** and **MATH1840** or **MATH1850** and **MATH1860**).

#### **4. Writing Across the Curriculum (WAC) Requirement**

Students must pass two writing intensive courses approved by their adviser. Many courses will require completion of Composition I and II (or HON 1010 and HON 1020) as pre-requisites. The College of Natural Sciences and Mathematics recommends that the first of these writing intensive courses be completed within the first 65 and the second within the first 90 hours. At least one of these courses must be taken within the student's major. In consultation with their advisers, students with dual or interdisciplinary majors will meet this requirement by selecting a course within one of their chosen majors.

Transfer students from institutions that have required writing intensive courses should have their former institution certify that they have completed a series of writing intensive courses comparable to those required in the College of Natural Sciences and Mathematics. Transfer students who have not taken writing intensive courses must meet the College of Natural Sciences and Mathematics Writing Across the Curriculum requirements.

**5. Natural Sciences/Mathematics** (UT General Education requirement is two courses for 6 hours; College of Natural Sciences and Mathematics requirement differs based on degree as indicated below).

a. Bachelor of Arts (BA)

Two science/mathematics courses from two different departments outside of the student's major are required. Students may select courses from biology, chemistry, environmental sciences, mathematics, and physics and astronomy. Courses must be major-level. See DAR for more information.

b. Bachelor of Science (BS)

Three science/mathematics courses from three different departments outside of the student's major are required. Students may select courses from biology, chemistry, environmental sciences, mathematics, and physics and astronomy. Courses must be major-level. See DAR for more information.

**6. Cultural Experience (Bachelor of Arts (BA) requirement only, not required for Bachelor of Science (BS))**– 0 to 8 hours (foreign languages 1110 and 1120 (or 1500) or one semester of Study Abroad)

Every student enrolled in a BA degree program in the College of Natural Sciences and Mathematics is required to demonstrate proficiency in a single foreign language (Arabic, Chinese, French, German, Japanese, Latin, Spanish, or American Sign Language) through the elementary (foreign languages 1120) level by successfully completing a foreign language course at this level or by achieving an appropriate score on a proficiency/placement test administered by the department of foreign languages that reflects the equivalent. Students beginning a foreign language should enroll in their chosen language at the elementary 1110 level and will take two semesters of foreign language. Those continuing a foreign language or attempting to demonstrate competency by examination should take a proficiency/placement test. Alternatively, students may satisfy the cultural experience requirement by studying abroad for at least once semester in an approved study abroad/exchange program for academic credit.

**G. Natural Sciences and Mathematics Distributive Requirements (Bachelor of Arts (BA) requirement only, not required for Bachelor of Science (BS))**

Students should consult with their advisers in selecting courses that will meet distributive requirements. With their Adviser's approval, students may select higher-level courses for which they have the prerequisites. With careful planning, students will be able to satisfy UT General Education Curriculum and College of Natural Sciences and Mathematics requirements by taking the minimum required hours. A student may take no more than two courses under each departmental code in satisfying the distributive requirements.

- 1. Humanities and Fine Arts** (UT General Education requirement is two courses for six hours; students enrolled in a BA degree program in the College of Natural Sciences and Mathematics are required to take an additional 9 hours). Students will take five courses (15 hours) in the humanities in addition to those taken to meet the English composition and foreign language requirements. Students may select humanities courses that also will satisfy a UT General Education humanities or multicultural requirement.

**Required Courses** – 15 hours (see suggested courses listed below):

**English Literature** – 3 hours

**History** – 3 hours

**Fine Arts** – 3 hours (course must be an appreciation or theory course, not a studio or skills course)

**Electives** – two courses for 6 hours Students may select courses from art, art history, communication, English, film, foreign languages (courses higher than 1120/1500 or culture courses 1080 and 1090, or a second foreign language), history, humanities, music, philosophy, religious studies and theatre.

Among the courses with minimal or no prerequisites are as follows: ARTH 1500; CLC 1010; COMM 1010, 2000; ENGL 2710, 2720, 2730, 2740 and 2760; FILM 1310; FREN 1080 and 1090; GERM 1080 and 1090; HIST 1000 through 1200; HUM 1010, 1200, 2220, 2010 and 2020; JAPN 1080 and 1090; MUS 2200, 2210, 2220, 2240, 2250 and 2420; PHIL 1010, 1020, 2200 and 2400; REL 1220 and 2000; SPAN 1080, 1090 and 1100; and THR 1010 and 1100. However, higher-level humanities courses will satisfy these requirements and may be taken if student has met the prerequisites.

2. **Social Sciences** (UT General Education requirement is two courses for six hours; Students in a BA degree program in the College of Natural Sciences and Mathematics are required to take one additional course for a total of nine hours).

Students may select social science courses that also will meet a UT General Education social science requirement and one multicultural requirement. Students may select courses from anthropology, economics, geography, political science, psychology, and sociology. Among the courses with minimal or no prerequisites areas follows: ANTH 1020, 2020, 2800, and 2900; ECON 1010, 1150 and 1200; GEPL 1010 and 1100; PSC 1200, 1300, 1400 and 1710; PSY 1010; and SOC 1010 and SOC 1750. No more than two courses can be from a single discipline.

## H. Major Area

Every student must complete either a departmental major or an interdepartmental or interdisciplinary major. Courses given in other colleges of the University may be credited to the major only with the approval of the Dean of the College of Natural Sciences and Mathematics upon recommendation of the department Chair. Waiver of a required course or the substitution of a course from another department does not necessarily reduce the minimum credits required in the major.

### 1. Departmental Major

**See the complete list of departmental majors under “Degrees Offered” in the College of Natural Sciences and Mathematics section of this catalog.**

The minimum number of semester hours a student must complete for a departmental major is 34 hours. A student may have two majors from two different departments provided the requirements of both programs are satisfied. Work in the second major may be accepted as fulfilling the related course requirement upon the approval of the Advisers in both departments. A student cannot use courses from the first major to satisfy the second and vice-versa. See section on “Earning a Second Degree” for statement on requirements when two or more desired major programs are offered as different degrees.

### 2. Interdisciplinary Majors

A student may complete one of the interdisciplinary majors if accepted into that particular program. A student completing a departmental major and a second major in an interdisciplinary or interdepartmental major cannot use courses from the first major to satisfy the second or vice-versa. See the complete list of interdisciplinary majors under “Degrees Offered” in the College of Natural Sciences and Mathematics section of this catalog.

## I. Related Courses

Every student who chooses a departmental major and students in some interdisciplinary majors also must complete courses related to the major. These courses must be in addition to courses taken to fulfill the basic requirements listed above. For BA degree programs the minimum

number of major and related area courses is 58 hours. For BS degree programs the minimum number of major and related area courses is 64 hours. Each department defines the areas from which courses may be chosen by its majors, and these listings are given in the later sections of this catalog under Programs of Study. For most programs, related courses must be chosen from courses acceptable for credit in a College of Natural Sciences and Mathematics major. Generally, these are upper-level courses.

Courses given in other colleges of the University may be credited to the major or to related courses only if indicated in later sections of the this catalog under Programs of Study or with the approval of the Dean of the College of Natural Sciences and Mathematics upon recommendation of the department Chair.

### **J. Minors**

Many College of Natural Sciences and Mathematics departments offer minors. Departmental requirements for particular minors are given in later sections of the catalog under Programs of Study. Students wishing to pursue minors should consult with their primary program Advisers and then with an Adviser in Student Services office. Not all minors can be added to all degree programs. Courses selected for the minor must be chosen from courses acceptable for credit toward a major in that department. In meeting requirements for some majors, work in the minor may be accepted as fulfilling the required hours of related courses, but only with the approval of the student's major Adviser. Students completing a minor must be sure that at least 12 credit hours of the minor requirements are unique to that minor, and are not being used to satisfy requirements in the major or another minor. No more than six hours of courses taken for minor credit may be applied to the total College of Natural Sciences and Mathematics distributive requirements. A minimum GPA of 2.0 is required in the minor. Students must complete a minimum of 21 hours for a minor; at least nine of those hours must be completed at The University of Toledo.

### **Pre-medical, Pre-dental and Pre-veterinary Concentrations**

Sharon L. Schnarre, Adviser

Students interested in professional medical, dental or veterinary careers may choose to apply for the pre-medical, pre-dental and pre-veterinary concentrations. **Students choosing this option must also complete the requirements for a major in a specific discipline or in an interdisciplinary baccalaureate program.**

Because admission to a professional school is very competitive, students need to maintain high GPAs, both cumulative and in the sciences. The pre-medical/pre-dental/pre-veterinary adviser will continually monitor a student's academic performance and make recommendations as to whether this program should be continued. If at any time a student's GPA drops below a 3.0, the student will be dropped from the program, unless extenuating circumstances exist, in which case the student will be placed on a probationary status until the grades improve.

The pre-medical/pre-dental/pre-veterinary adviser will assist the student in determining the entrance requirements of the professional school being considered, since these requirements vary among schools. In general, these professional schools specify for entrance a core set of science courses that include one year (two semesters) each of biology, general chemistry, organic chemistry, physics and mathematics. Most schools recommend that candidates plan a broad course of study leading to either a B.A. or a B.S. degree in any discipline.

### **Honors**

Honors in the College of Natural Sciences and Mathematics is available to its academically talented and highly motivated students, and is offered in conjunction with the University of Toledo Jesup Scott Honors College. A departmental honors curriculum is also offered by individual departments within the College of Natural Sciences and Mathematics.

## Statement on Academic Dishonesty

A student found to be academically dishonest by a faculty member may appeal, in order, to the department Chair, the Associate Dean of the College of Natural Sciences and Mathematics, the NSM Council Committee on Academic Grievance and the University student grievance council.

See <http://www.utoledo.edu/nsm/pdfs/NSM%20Policies%20and%20Procedures.pdf> for more information on the steps and timeline of the appeals process within the College, prior to the petitioning the Student Grievance Council.

The procedures for making an appeal to the student grievance council may be found in The University of Toledo Student Handbook:

<http://www.utoledo.edu/studentaffairs/pdfs/studenthandbook.pdf>. Criteria governing this policy are detailed in undergraduate policy 3364-71-04: Academic Dishonesty:

<http://www.utoledo.edu/policies/academic/undergraduate/pdfs/3364-71-04%20%20Academic%20dishonesty.pdf>.

## Astronomy

(Administered by the Department of Physics and Astronomy)

Sanjay V. Khare, Chair

Scott Lee, Undergraduate Adviser

## Degrees Offered

The department of physics and astronomy offers a program of study leading to the Bachelor of Arts in astronomy. There is also an astrophysics concentration for the Bachelor of Science in physics (see Physics section later in this catalog; this concentration is recommended for those students wishing to earn a Ph.D. later).

## Requirements for the Bachelor of Arts in Astronomy

The B.A. in astronomy program consists of 40 hours of required astronomy and physics courses in the Department of Physics and Astronomy, 15 hours of mathematics, and at least 9 additional hours in the natural sciences and mathematics, chosen with the Adviser's approval. This program is intended to provide the combination of fundamental physics, together with general and advanced astronomy, required for a career in astronomy or a related area. It also has the flexibility required by students who wish to pursue interdisciplinary studies or prepare for careers in teaching or other professions requiring a fundamental understanding of the physical sciences.

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COURSE REQUIREMENTS	COMMENTS
<b>First Term</b>	NSM	1000	Orientation	2	None	Or electives to reach 124 hours
	PHYS	1910	Frontiers of Physics	3	None	
	ASTR	2010	Solar System Astronomy	3	None	
			Foreign Lang I	4		
	MATH	1830or1850or1920	CALCULUS I	4	MATH 1340 if necessary	
<b>Total</b>				<b>16</b>		
<b>Second Term</b>	PHYS	2130	Physics for Sci Majors I	5	None	or PHYS 2070 (or PHYS 2140)
	MATH	1840or1860or1930	CALCULUS II	4	MATH 1850	or MATH 1840, 1930
	ASTR	2020	Stars, Galaxies, and the Universe	3	ASTR2010	

			Foreign Lang II	4	Foreign Lang I	(or Foreign Lang I)
<b>Total</b>				<b>16</b>		
<b>Third Term</b>						
	PHYS	2140	Physics for Sci Majors II	5	PHYS 2130	or PHYS 2080 and 2100 (or Foreign Lang II)
	ENGL	1110	English Composition I	3	None	
	MATH	2850	Calculus III	4		or MATH 2950
	MATH	3610	Statistical Methods I	3	MATH 1840or1860or1930	
<b>Total</b>				15		If 16, take one less course in future semester
<b>Fourth Term</b>						
	ASTR	3880	Foundations of Astronomy	4	ASTR2020 and PHYS 2140 or 2100	
			Choose one from BIOL 2150 to 4xxx, CHEM 1230 to 4xxx, EEES 2010 to 4xxx	3-4		
			Core Social Science I	3		
	ENGL	1130	English Composition II	3	ENGL 1110	or ENGL 1140, 1150, 2950, 2960
	Elective		Elective(s) > 3000-level -to reach 120 hours	1-2		
<b>Total</b>				<b>15</b>		

### SPECIAL CONSIDERATIONS

(e.g. Students must be accepted into upper division; Acceptance requires the completion of 60 semester credit hours of approved courses and a minimum grade point average of 2.25)

<b>Fifth Term</b>						
	PHYS	3310	MODERN PHYSICS - WAC	3	MATH 1860, PHYS 2140 or 2100	
	Electives		3000-4000 level Phys	3		
			Core Social Science II	3		
			History	3		
			Core Humanities I	3		
<b>Total</b>				15		
<b>Sixth Term</b>						
	Electives		3000-4000 level Phys	3		
			Choose one from BIOL 2150 to 4xxx, CHEM 1230 to 4xxx, EEES 2010 to 4xxx	3-4		
			Soc Sci	3		
			Fine Arts	3		
	Elective		Elective(s)-to reach 120 hours	2-3		
<b>Total</b>				<b>15</b>		
<b>Seventh Term</b>						





	PHYS	4950	PROFESSIONAL DEVELOPMENT	1	
	ASTR	4810	ASTROPHYSICS I	3	ASTR3xxx
	ASTR	4810	ASTROPHYSICAL MEASUREMENTS	3	ASTR3xxx
	Eng Lit		College Requirement	3	
			US Diversity	3	
	Elective		Elective(s) > 3000-level -to reach 120 hours	3	
<b>Total</b>				<b>16</b>	
<b>Eighth Term</b>					
	PHYS	4920	PHYSICS CAPSTONE PROJECT	1	
	ASTR	4820	ASTROPHYSICS II	3	ASTR4810
			Core Humanities II	3	
			Non-Western	3	
			WAC	3	
<b>Total</b>				<b>13</b>	
			<b>Total Earned Credit Hours</b>	<b>120</b>	

### Comments on BA in Astronomy Curriculum:

**Recommended introductory course:** PHYS 1910 is strongly recommended.

**Basic astronomy sequence:** The sequence ASTR 2010 and 2020 (6 hours) is required.

**Advanced astronomy courses:** The advanced courses ASTR 3880, 4810, 4820 and 4880 (13 hours) are required.

**Basic Physics sequence:** Either the sequence PHYS 2130 and 2140 (10 hours), or the sequence PHYS 2070, 2080 and 2100 (12 hours) is required. In addition, PHYS 3310, and 4920, 4950 and 6 additional hours of physics courses numbered 3000 or higher (11 hours) are required.

**Mathematics courses:** One of MATH 1830, 1850 or 1920, one of MATH 1840, 1860 or 1930, and one from MATH 2850, 2880 or 2950 and MATH 3610 (15 hours) are required.

**Other courses in related areas:** At least 9 additional hours of natural sciences courses must be taken, of which at least two courses must be in be major-level chosen from at least two of the departments: biology, chemistry, or environmental sciences, approved by the student's Adviser. Possibilities include BIOL 2150, 2160, 2170 and 2180; CHEM 1230, 1240, 1280 and 1290; and EEES 2010 and 2100.

### Department of Biological Sciences

Bruce Bamber, Chair

Deborah Chadee, Associate Chair

Amanda Seabolt, Undergraduate Advisor, Honors Advisor

Catherine Shaffner, Medical Technology Program Director and Advisor

Brian Ashburner, Advisor for the University of Salford Exchange Program

### Degrees Offered

The Department of Biological Sciences offers a degree program for a bachelor of science and bachelor of arts in biology, and a bachelor of science in Medical Technology. A concentration in neuroscience is available to students in the bachelor of science in biology program. The

department of Environmental Sciences also offers a degree program for a bachelor of science in biology, with a concentration in ecology and organismal biology (see that department's section for requirements).

### Advanced Placement

Students with a score of 3 will receive credit for BIOL 1120; students with a score of 4 will receive credit for BIOL 2170; students with a score of 5 will receive credit for BIOL 2150 and 2170.

Students earning Advanced Placement (AP) scores of 4 or 5 may receive credit for BIOL 2160 and/or BIOL 2180 upon evaluation of their AP laboratory materials by the department of biological sciences.

### Requirements for the Bachelor of Science in Biology

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COURSE REQUIREMENTS	COMMENTS
<b>First Term</b>						
		NSM	1000	Orientation	2	
		BIOL	2170	Fund of Life Science Cells	4	ACT20 or CHEM 1090 or BIOL 2010
		BIOL	2180	Fund of Life Science Lab	1	
		CHEM	1230	General Chemistry I	4	CHEM 1090 with D- min or CHEM placement score of 17
		CHEM	1280	General Chemistry I Lab	1	
		ENGL	1110	College Composition I	3	
				15		
<b>Second Term</b>						
		BIOL	2150	Fund of Life Science Div of Life	4	CHEM 1090 with D- min, CHEM 1230 with D- min, or BIOL 2150 with D- min
		BIOL	2160	Fund of Life Science Lab	1	
		CHEM	1240	General Chemistry II	4	CHEM 1230 with D- min
		CHEM	1290	General Chemistry II Lab	1	
		ENGL	1130-1230	College Composition II	3	ENGL 1110 with D-, HON 1010 with D-, or ENGL placement 1130
				Humanities Core	3	
				16		
<b>Third Term</b>						
		BIOL	3010	Molecular Genetics	3	BIOL 2170, C or better and CHEM 1220 or 1230 with D- min
		BIOL	3020	Molecular Genetics Lab*	2	BIOL 3010 corequisite
		CHEM	2410	Organic Chemistry I	3	CHEM 1240 with D- min
		CHEM	2460	Organic Chemistry I Lab	1	CHEM 1240 with D- min and CHEM 1290 with D- min
		MATH	1750 or 1830 or 1850	Calculus I	4	Math 1320 and 1330 or Math 1340 or ACT math 27/SAT math 610 and Trig placement score 12 or ACT math 22/SAT math 520 and CA placement score 15 and Trig placement score 12
				Social Science Core	3	
				16		

\*May take different 3000-4000 level lab in different semester, 2 are required.

<b>Fourth Term</b>					
	BIOL	3030	Cell Biology	3	BIOL 2170 C min
			Humanities Core	3	
	CHEM	2420	Organic Chemistry II	3	CHEM 2410 D- min
	MATH	1760 or 1840 or 1860	Calculus II	3-4	MATH 1750 D- min, MATH 1830 D- min or MATH 1850 D- min
			Social Science Core	3	
				15- 16	
<b>Fifth Term</b>					
	BIOL	3090	Developmental Biology	3	BIOL 3030 C min
	BIOL	3100	Developmental Biology Lab	1	BIOL 3090 corequisite
	PHYS	2070	General Physics I	5	
	CHEM	3510	Biochemistry I	3	CHEM 2420, D- min
			US Diversity	3	
				15	
<b>Sixth Term</b>					
	BIOL	3070	Human Physiology	3	BIOL 3030 C min
	PHYS	2080	General Physics II	5	PHYS 2070 D- min
	CHEM	3520	Biochemistry II	3	CHEM 3510, D- min
			WAC Elective	3	
			Non-Western	3	
				17	
<b>Seventh Term</b>					
	BIOL	4700	Biol Lit and Commun	3	BIOL 3030 C min
	BIOL	3XXX/4XXX	Major Requirement**	3	
			Humanities Elective	3	
			Electives to get to 124 hours	9	
				15	
<b>Eighth Term</b>					
	BIOL	3XXX/4XXX	Major Requirement**	3	
	MATH	2600 or 2640	Statistics	3	
			Electives to get to 124 hours	9	
				15	
			<b>Total Earned Credit Hours</b>	<b>124</b>	

\*May take different 3000-4000 level lab in different semester, 2 are required.

\*\*9 hours of 3000-4000 level BIOL electives are required. Hours from the 3000-4000 level BIOL lab requirement count toward requirement.

\*\*9 hours of 3000-4000 level BIOL electives are required. Hours from the 3000-4000 level BIOL lab requirement count toward requirement.

### Comments on BS in Biology Curriculum:

The B.S. program requires at least 34 hours of biology and includes a core of BIOL 2150, 2160, 2170, 2180, 3010, 3030, 3070 and 3090. In addition, students must complete at least nine hours of biology elective courses numbered above BIOL 3000, which must include at least two courses with laboratory or field experiences. Undergraduate research (BIOL 4910) not applied to Departmental Honors may be used to fulfill one of the two laboratory requirements. A

maximum of three credit hours of BIOL 4910 not applied to Departmental Honors may be used to fulfill biology elective credits. Finally, students must complete BIOL 4700 in their final year.

Cognate course work in mathematics, physics and chemistry also is required as follows: MATH 1750 and 1760 or MATH 1830 and 1840 or MATH 1850 and 1860; MATH 2600, 2640 or PSY 2100; PHYS 2070 and 2080 or PHYS 2130 and 2140; CHEM 1230, 1240, 1280, 1290, 2410, 2420, 2460, 3510 and 3520.

### Neuroscience Concentration:

A concentration in neuroscience is available to students pursuing a BS in Biology.

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COURSE REQUIREMENTS	COMMENTS	
<b>First Term</b>							
		NSM	1000	Orientation	2		
		BIOL	2170	Fund of Life Science Cells	4	ACT20 or CHEM 1090 or BIOL 2010	
		BIOL	2180	Fund of Life Science Lab	1		
		CHEM	1230	General Chemistry I	4	CHEM 1090 with D-min or CHEM placement score of 17	
		CHEM	1280	General Chemistry I Lab	1		
		ENGL	1110	College Composition I	3		
				15			
<b>Second Term</b>							
		BIOL	2150	Fund of Life Science Div of Life	4	CHEM 1090 with D-min, CHEM 1230 with D- min, or BIOL 2150 with D- min	
		BIOL	2160	Fund of Life Science Lab	1		
		CHEM	1240	General Chemistry II	4	CHEM 1230 with D-min	
		CHEM	1290	General Chemistry II Lab	1		
		ENGL	1130-1230	College Composition II	3	ENGL 1110 with D-, HON 1010 with D-, or ENGL placement 1130	
				Humanities Core	3		
				16			
<b>Third Term</b>							
		BIOL	3010	Molecular Genetics	3	BIOL 2170, C or better and CHEM 1220 or 1230 with D- min	
		BIOL	3020	Molecular Genetics Lab*	2	BIOL 3010 corequisite	*May take different 3000-4000 level lab in different semester, 2 are required.
		CHEM	2410	Organic Chemistry I	3	CHEM 1240 with D-min	
		CHEM	2460	Organic Chemistry I Lab	1	CHEM 1240 with D-min and CHEM 1290 with D- min	
		MATH	1750 or 1830 or 1850	Calculus I	4	Math 1320 and 1330 or Math 1340 or ACT math 27/SAT math 610 and Trig placement score 12 or ACT math 22/SAT math 520 and CA placement score 15 and Trig placement score 12	



			Social Science Core	3	
				16	
<b>Fourth Term</b>					
	BIOL	3030	Cell Biology	3	BIOL 2170 C min
			Humanities Core	3	
	CHEM	2420	Organic Chemistry II	3	CHEM 2410 D- min
	MATH	1760 or 1840 or 1860	Calculus II	3-4	MATH 1750 D- min, MATH 1830 D- min or MATH 1850 D- min
			Social Science Core	3	
				15- 16	
<b>Fifth Term</b>					
	BIOL	3090	Developmental Biology	3	BIOL 3030 C min
	PSY	2400	Cognitive Psychology	3	PSY1010
	PHYS	2070	General Physics I	5	
	CHEM	3510	Biochemistry I	3	CHEM 2420, D- min
			US Diversity	3	
				15	
<b>Sixth Term</b>					
	BIOL	3070	Human Physiology	3	BIOL 3030 C min
	PHYS	2080	General Physics II	5	PHYS 2070 D- min
	CHEM	3520	Biochemistry II	3	CHEM 3510, D- min
			WAC Elective	3	
			Non-Western	3	
				17	
<b>Seventh Term</b>					
	BIOL	4700	Biol Lit and Commun-- NEURO	3	BIOL 3030 C min
					**9 hours of 3000-4000 level BIOL electives are required. Hours from the 3000-4000 level BIOL lab requirement count toward requirement.
	BIOL	4250	Introduction to Neurobiology	3	
	BIOL	3XXX- 4XXX	Biology Elective	3	
	PSY	3400	Cognitive Neuropsychology	3	PSY2400
				15	Or PSY 3610
<b>Eighth Term</b>					
					**9 hours of 3000-4000 level BIOL electives are required. Hours from the 3000-4000 level BIOL lab requirement count toward requirement.
	BIOL	4910- Neuro	Neuro Research	3	
	MATH	2600 or 2640	Statistics	3	
			Electives to get to 124 hours	9	
				16	
			<b>Total Earned Credit Hours</b>	<b>124</b>	



## Comments on BS in Biology Curriculum:

The program requires at least 34 hours of BIOL courses, and either PSY 3400 or PSY3610. The following courses are required: BIOL 2150, 2160, 2170, 2180, 3010, 3030, 3070, 3090, and 4250. In addition, students must complete 3 hours of undergraduate research (BIOL 4910) in the area of neuroscience, BIOL 4700 (must be a section with a neuroscience focus), PSY3400 or PSY3610, and at least three hours of Biology electives numbered above BIOL 3000, which must include at least 1 laboratory course.

## Requirements for the Bachelor of Arts in Biology

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COURSE REQUIREMENTS
<b>First Term</b>					
	NSM	1000	ORIENTATION	2	
	ENGL	1110	COMP I	3	
	CHEM	1230	GEN CHEMISTRY I	4	
	CHEM	1280	GEN CHEMISTRY I LAB	1	
	MATH	1320	COLLEGE ALGEBRA	3	
			CORE HUMANITIES I	3	
				16	
<b>Second Term</b>					
	BIOL	2170	FUND OF LIFE SCIENCE Cells	4	
	BIOL	2180	FUND OF LIFE SCIENCE LAB	1	
	CHEM	1240	GEN CHEMISTRY II	4	
	CHEM	1290	GEN CHEMISTRY II LAB	1	
	MATH	1330	TRIG	3	
	ENGL	1130-1150	COMP II	3	
				16	
<b>Third Term</b>					
	BIOL	2150	FUND OF LIFE SCIENCE Div of Life	4	
	BIOL	2160	FUND OF LIFE SCIENCE LAB	1	
	CHEM	2410	ORGANIC CHEMISTRY I	3	
	CHEM	2460	ORGANIC CHEMISTRY I LAB	1	
			FOREIGN LANG I	4	
			CORE SOCIAL SCIENCE I	3	
				16	
<b>Fourth Term</b>					
	BIOL	3010	MOLECULAR GENETICS	3	
	CHEM	2420	ORGANIC CHEMISTRY II	3	
	CHEM	2470	ORGANIC CHEMISTRY II LAB	1	
			FOREIGN LANG II	4	
			CORE HUMANITIES II	3	
				14	
<b>Fifth Term</b>					
	BIOL	3030	CELL BIOLOGY	3	
	PHYS	2070	PHYSICS I	5	
			CORE SOCIAL SCIENCE II	3	
			COLLEGE REQ-FINE ARTS	3	
			WAC	3	

				17	
<b>Sixth Term</b>					
	BIOL	3070	HUMAN PHYSIOLOGY	3	
	PHYS	2080	PHYSICS II	5	
			US DIVERSITY	3	
			COLLEGE REQ-SOC SCIENCE	3	
				14	
<b>Seventh Term</b>					
	BIOL	3xxx/4xxx	3000-4000 LEVEL BIOL ELECTIVES	6	
	MATH	2600 or 2640	STATISTICS	3	
			COLLEGE REQ-ENGL LIT	3	
			NON-WESTERN	3	
				15	
<b>Eighth Term</b>					
	BIOL	4700	BIOL WAC	3	
	BIOL	3xxx/4xxx	3000-4000 LEVEL BIOL ELECTIVE	5	
			COLLEGE REQ-HISTORY	3	
			COURSES NEEDED TO REACH 124 HOURS	5	
				16	
			<b>Total Earned Credit Hours</b>	<b>124</b>	

### Comments on BA in Biology Curriculum:

The B.A. program requires at least 33 hours of biology and includes a core of BIOL 2150, 2160, 2170, 2180, 3010, 3030 and 3070. In addition, students must complete at least eleven hours of biology elective courses numbered above BIOL 3000. A maximum of three credit hours of BIOL 4910 not applied to Departmental Honors may be used to fulfill biology elective credits. Finally, students must complete BIOL 4700 in their final year.

Cognate course work in mathematics, physics and chemistry also is required as follows: MATH 1320, 1330 and MATH 2600 (or MATH 2640 or PSY 2100) or MATH 1340 and MATH 2600 (or MATH 2640 or PSY 2100) or MATH 1750 and 1760; PHYS 2070 and 2080 or PHYS 2130 and 2140; CHEM 1230, 1240, 1280, 1290, 2410, 2420, 2460 and 2470.

No classes used to satisfy the requirements of the Biology major or minor may be taken P/NC with the exceptions of BIOL 4910, BIOL 4950, and BIOL 4990.

### Requirements for the Minor in Biology

The minor in biology requires 22 credits including the following required courses: BIOL 2150, 2160, 2170, 2180, 3010, 3030 and 6 credits of elective courses at the 3xxx-4xxx level.

### Honors in Biology

The Department of Biological Sciences Honors Program is available for qualified majors. Interested students contact the departmental honors Adviser before the beginning of the sophomore year.

To receive an undergraduate degree with honors in biology, all requirements for the B.S. or B.A. degree plus an additional 6 credits of Undergraduate Research/Honors Thesis (BIOL 4910) must be completed with a minimum GPA of 3.2 overall and in BIOL courses. The program of study must include honors sections of at least two biology courses in addition to BIOL 4910. The Undergraduate Research/Honors Thesis credits are completed under the direction of a faculty research director selected by the student. Students must submit a written Honors Thesis to the department before completion of their senior year and make a formal public presentation of their research (typically at the spring Biology Undergraduate Research Symposium). The requirement of Honors Thesis research may be fulfilled in one of three ways:

1. Laboratory research in a Biosciences faculty member's laboratory;
2. Laboratory research in a summer or academic year program, in which the student carries out full-time independent research for at least 10 weeks under the direction of a senior scientist on a topic approved by the departmental honors Adviser and/or the department Chair;
3. Laboratory research in the laboratory of a senior scientist who is not a member of the department of biological sciences on a topic approved by the departmental honors Adviser and/or the department Chair.

For options 2 and 3, it is very important that the student get his/her proposed thesis research project approved in advance by the departmental honors Adviser and/or the department Chair, who will monitor progress and direct the 4910 courses.

### **Junior Year Studies in England for Biology Majors**

The Department of Biological Sciences participates in a well-established exchange program with the University of Salford, England. Selected UT biology (and pre-medical, pre-dental and pre-veterinary) students have the opportunity to spend their junior year at Salford. Participants in the program will pay their instructional and general fees to The University of Toledo. Eligibility to participate in the program is based on criteria established by the Department of Biological Sciences. Information on the program may be obtained from the departmental exchange program Adviser, Dr. Brian Ashburner. Details are available on academic issues, living accommodations, recreational opportunities and life in England on the departmental Web site at <http://www.utoledo.edu/nsm/bio/salford/>

### **Bachelor of Science in Medical Technology Program**

This degree program prepares you for certification as a Medical Laboratory Scientist (Medical Technology Scientist). You will complete three years of baccalaureate college work, and then complete 12 months of hospital based clinical training in medical technology. A certification examination is taken at the successful completion of a hospital training program. The requirements for certification are established by the Board of Certification of the American Society of Clinical Pathologists.

Acceptance into the clinical year of the program is competitive and application is made during the fall of the Junior year. In order to be admitted to the clinical year, completion of 90 semester hours of college work with an accumulated GPA of no less than 2.5 overall and a grade of C or better in the pre-clinical science courses is required.

The clinical program in the fourth year includes externship sites at the University of Toledo Medical Center laboratory and ProMedica hospital laboratories. Upon successful completion, you will be awarded the degree of Bachelor of Science in Medical Technology and you are then eligible to take the national certification examination.

A description of the program is available at

<http://www.utoledo.edu/nsm/bio/undergrad/medtech.htmlh>. The description includes a sample 4-year curriculum. The medical technology adviser will assist students in planning the sequence in which the pre-clinical courses are taken during the student's years at the university. Therefore, interested applicants should consult with the medical technology adviser, Catherine Shaffner, before selecting this professional career option.



Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COURSE REQUIREMENTS
<b>First Term</b>					
	BIOL	2170	Fund of Life Science Cells	4	ACT20 or CHEM 1090 or BIOL 2010
	BIOL	2180	Fund of Life Science Lab	1	
	CHEM	1230	General Chemistry I	4	CHEM 1090 with D-min or CHEM placement score of 17
	CHEM	1280	General Chem I Lab	1	
	ENGL	1110	College Composition I	3	
	NSM	1000	Orientation	2	
<b>Second Term</b>					
	BIOL	2150	Fund of Life Science Div. of Life	4	CHEM 1090 with D-min, CHEM 1230 with D- min, or BIOL 2150 with D-min
	BIOL	2160	Fund of Life Science Lab	1	
	CHEM	1240	General Chemistry II	4	CHEM 1230 with D-min
	CHEM	1290	General Chemistry II Lab	1	
	ENGL	2950	Sci & Tech Rpt Writing	3	ENGL 1110 with D-, HON 1010 with D-, or ENGL placement 1130
	Core Elective		(Humanities)	3	
<b>Third Term</b>					
	BIOL	3030	Cell Biology	3	BIOL 2170 C min and CHEM 1220 or 1230 with D- min
	CHEM	2410	Organic Chemistry I	3	CHEM 1240 with D-min
	CHEM	2460	Organic Chemistry I Lab	1	CHEM 1240 with D-min and CHEM 1290 with D- min
	MATH	1320	College Algebra	3	
	MATH	2600	Introduction to Statistics	3	
	Core Elective		(Social Science)	3	
<b>Fourth Term</b>					
	BIOL	3010	Molecular Genetics	3	BIOL 2170, C or better and CHEM 1220 or 1230 with D- min
	KINE	2510	Human Anatomy	3	
	KINE	2520	Human Anatomy Lab	1	
	CHEM	2420	Organic Chemistry II	3	CHEM 2410 D- min
	CHEM	2470	Organic Chemistry II Lab	1	
	Core Elective		(Humanities)	3	

	MEDT	2010	Clin. Lab Techniques	2	BIOL 2170 and BIOL 2180 and CHEM 1240 and CHEM 1290 with D-minimum
<b>Fifth Term</b>					
	BIOL	4050	Immunology	3	BIOL 3030 C min
	BIOL	4060	Immunology Lab	1	
	PHYS	2070	General Physics I	5	
	Core Elective		(Social Science)	3	
	Core Elective		(Multicultural)	3	
<b>Sixth Term</b>					
	BIO	3070	Human Physiology	3	BIOL 3030 D- min
	PHYS	2080	General Physics II	5	PHYS 2070 D- min
	BIOL	4030	Microbiology	3	BIOL 3030 and CHEM 2410 D-min
	BIOL	4040	Microbiology Lab	1	
	Core Elective		(Multicultural)	3	

**Must be accepted into the program at this point**

**Seventh Term**

	MEDT	4020	Clinical Hematology	5	Instructor Approval Required
	MEDT	4030	Clinical Urinalysis, Body Fluids, and Hemostasis	3	Instructor Approval Required
	MEDT	4100	Clinical Virology	2	Instructor Approval Required
	MEDT	4080	Clinical Immunohematology	5	MEDT 4020 Minimum Grade of C
<b>Eighth Term</b>					
	MEDT	4040	Clinical Chemistry	5	Instructor Approval Required
	MEDT	4050	Clinical Microbiology	5	BIOL 4030 and BIOL 4040 Minimum Grade of D-
	MEDT	4060	Clinical Immunology	3	BIOL 4050 minimum grade of D-
	MEDT	4070	Clinical Parasitology	2	Instructor Approval Required

<b>Ninth Term</b>					
	MEDT	4090	Clinical Mycology	2	MEDT 4050 Minimum Grade of C
	MEDT	4950	Clinical externship: Management	1	Instructor Approval Required
	MEDT	4500	Clinical Research and Clinical Correlation	3	Instructor Approval Required
	MEDT	4951	Clinical Externship: Microbiology	4	MEDT 4050 Minimum Grade of C
<b>Tenth Term</b>					
	MEDT	4952	Clinical Externship: Chemistry	4	MEDT 4040 Minimum Grade of C
	MEDT	4953	Clinical Externship: Hematology	3	MEDT 4020 Minimum Grade of C
	MEDT	4954	Clinical Externship: Immunochemistry	3	MEDT 4020 Minimum Grade of C

**Total Earned Credit Hours    143**

### Department of Chemistry & Biochemistry

Jon R. Kirchhoff, Chair and Distinguished University Professor

Cora Lind-Kovacs, Associate Chair

Donald Ronning, Director of Graduate Studies

John Bellizzi, Undergraduate Advising Coordinator, Honors Adviser

Xiche Hu, Undergraduate Adviser

Edith Kippenhan, Undergraduate Adviser

Timothy Mueser, Undergraduate Adviser

Joseph Schmidt, Undergraduate Adviser, Honors Adviser

Jianglong Zhu, Undergraduate Adviser

James Zubricky, Undergraduate Adviser

### **Degrees Offered**

The Department of Chemistry and Biochemistry offers degree programs for a bachelor of arts or a bachelor of science in chemistry or biochemistry.

### **Advanced Placement**

Students with a score of 3 on the Chemistry Advanced Placement Exam will receive credit for CHEM 1100 and placement into CHEM 1230 and 1280; students with a score of 4 will receive credit for CHEM 1230 and 1280; students with a score of 5 will receive credit for CHEM 1230, 1280, 1240, and 1290.

**Requirements for the Undergraduate Major  
For the bachelor of arts degree in chemistry,**

TERM	SUBJECT	COURSE NUMBER	COURSE TITLE	CR HR	COURSE REQUIREMENTS	COMMENTS
<b>First</b>						
	CHEM	1230	General Chemistry I	4	***	
	CHEM	1280	General Chemistry Lab I	1	***	
	MATH	1830 or 1850	Calculus I For Mathematicians, Scientists And Educators or Single Variable Calculus I	4	***	
	ENGL	1110	College Composition I	3	***	
	NSM	1000	Orientation	2	***	
			Humanities/Fine Arts Core Elective I	3	***	
<b>TOTAL</b>				<b>17</b>		
<b>Second</b>						
	CHEM	1240	General Chemistry II	4	***	
	CHEM	1290	General Chemistry Lab II	1	***	
	MATH	1840 or 1860	Calculus I For Mathematicians, Scientists And Educators or Single Variable Calculus II	4	***	
	CHEM	1910	Survey of Research	1	***	
	ENGL	1130	College Composition II	3	***	
			Social Science Core Elective II	3	***	
<b>TOTAL</b>				<b>16</b>		
<b>Third</b>						
	CHEM	2410	Organic Chemistry I	3	***	
	CHEM	2480	Organic Separations And Elementary Synthesis	2	***	
	CHEM	3310	Analytical Chemistry	2	***	
		2850	Elementary Multivariable Calculus (Suggested)	3or4	<b>1</b> ***	
	PHYS	2070 or 2130	General Physics I or Physics For Science And Engineering Majors I	5	***	
<b>TOTAL</b>				<b>15-16</b>		if 16, may take one less hour in a future semester
<b>Fourth</b>						
	CHEM	2420	Organic Chemistry II	3	***	
	CHEM	2490	Synthesis And Identification Of Organic Compounds	2	***	
	CHEM	3360	Analytical Chemistry Laboratory-WAC	2	***	
	PHYS	2080 or 2140	General Physics II or Physics For Science And Engineering Majors II	5	***	
			Humanities/ Fine Arts Core Elective II	3	***	



<b>TOTAL</b>				<b>15</b>	
<b>Fifth</b>					
	CHEM	3710	Physical Chemistry for the Life Sciences I	3	***
	CHEM	3860	Advanced Laboratory I-WAC	2	***
	CHEM	3510 or 3610	Biochemistry I (Fall)	3	***
			Inorganic I (Spring)		***
	FL	1110	Foreign Language I	4	***
			Humanities/Fine Arts Elective: Fine Arts	3	***
<b>TOTAL</b>				<b>15</b>	
<b>Sixth</b>					
	CHEM	3720	Physical Chemistry for the Life Sciences II	3	***
	CHEM	3510 or 3610	Biochemistry I (Fall)	3	***
			Inorganic I (Spring)		***
			Social Science Core Elective II	3	***
	FL	1120	Foreign Language II	4	***
			Humanities/Fine Arts Elective: History	3	***
<b>TOTAL</b>				<b>16</b>	
<b>Seventh</b>					
			3000-4000 Chemistry elective	2to4	***
			Elective(s)-needed to reach 124 hours	1to3	***
			Multicultural Course, Non Western	3	***
			Multicultural Course US Diversity	3	***
			Humanities/Fine Arts Elective: English Literature	4	***
<b>TOTAL</b>				<b>16</b>	
<b>Eight</b>					
			Elective(s)-needed to reach 124 hours	13	***
			NSM Science Elective	3	***
					***
					***
<b>TOTAL</b>				<b>16</b>	
<b>1</b> Or choose from: BIOL 2170; EEES 2010, EEES 2100, EEES 2200, EEES3050, EEES4220, EEES 4450, MATH 2850, MATH 2890, MATH 3610, or any BIOL 4000 level course. If taking, or have taken MATH2850, this can be an elective					
*** See course catalog for pre- and co-requisites					
FL Foreign language to be decided by student and adviser.					

Not CHEM  
3910, 3920,  
4910, 4920



Courses which satisfy the College and University degree requirements can be determined by running a degree audit and looking at the list of courses presented as satisfying the requirement. Always try to take courses in which you have an interest.

### Comments on BA in Chemistry Curriculum:

37 hours of CHEM courses are required. The following courses must be included: CHEM 1230, 1240, 1280, 1290, 2410, 2420, 2480, 2490, 3310, 3360, 3710, 3720, either 3510 or 3610, and 3860. Additional courses to reach 37 hours in the major may be selected from the 3000 or 4000 level CHEM courses, excluding CHEM 3712, 3722, 3732, 3742, 3910, 3920, 4910, and 4920. The following related courses are required: MATH 1830 or 1850, MATH 1840 or 1860; PHYS 2070 and 2080; and one additional course selected from the following: MATH 2850, 2890, 3610, BIOL 2170 (or a 4000 level BIOL course), EEES 2010, 2200, 2400, 3050, 4220, 4450.

### For the bachelor of arts degree in biochemistry:

TERM	SUBJECT	COURSE NUMBER	COURSE TITLE	CR HR	COURSE REQUIREMENTS
<b>First</b>					
	CHEM	1230	General Chemistry I	4	***
	CHEM	1280	General Chemistry Lab I	1	***
	MATH	1750 or 1830 or 1850	Calculus For The Life Sciences With Applications I or Calculus I For Mathematicians, Scientists And Educators or Single Variable Calculus I	4	***
	ENGL	1110	College Composition I	3	***
	NSM	1000	Orientation	2	***
			Humanities/Fine Arts Core Elective I	3	***
				17	
<b>Second</b>					
	CHEM	1240	General Chemistry II	4	***
	CHEM	1290	General Chemistry Lab II	1	***
	MATH	1760 or 1840 or 1860	Calculus For The Life Sciences With Applications II or Calculus II For Mathematicians, Scientists And Educators or Single Variable Calculus II	3 or 4	***
	CHEM	1910	Survey of Research	1	***
	ENGL	1130	College Composition II	3	***
			Social Science Core Elective I	3	***
				15-16	15 or 16 (if 15, may take 1 less hour in a future semester)
<b>Third</b>					
	CHEM	2410	Organic Chemistry I	3	***
	CHEM	2460	Organic Chemistry Lab I	1	***
	CHEM	3310	Analytical Chemistry	2	***
			Humanities/Fine Arts Elective: English Literature	3	***
	PHYS	2070	General Physics I	5	***
				14	

<b>Fourth</b>					
	CHEM	2420	Organic Chemistry II	3	***
	CHEM	2470	Organic Chemistry Lab II	1	***
	CHEM	3360	Analytical Chemistry Laboratory-WAC	2	***
			Humanities/Fine Arts Elective: History	3	***
	PHYS	2080	General Physics II	5	***
				14	
<b>Fifth</b>					
	BIOL	2170	Fundamentals of Life Science:: Biomolecules, Cells, and Inheritance	4	***
	CHEM	3510	Biochemistry I	3	***
	FL	1110	Foreign Language I	4	
			Humanities/Fine Arts Elective: Fine Arts	3	***
			Elective-to get to 124 hours	3	
				17	
<b>Sixth</b>					
	CHEM	3560	Biochemistry Laboratory	2	***
	CHEM	3610	Biochemistry II	3	***
			Social Science Core Elective II	3	***
	BIOL	3030	Cell Biology	3	***
	FL	1120	Foreign Language II	4	
				15	***
<b>Seventh</b>					
	CHEM	3710	Physical Chemistry for the Life Sciences I	3 or	
	CHEM	4570	or Biophysical Chemistry	4	
			Elective(s)-to get to 124 hours	6-8	***
<b>Choose One Course +</b>	CHEM	3720	Physical Chemistry For the Life Sciences II (Spring)	3	***
		3860	Advanced Laboratory I (WAC) (Fall)	2	
		4500	Advanced Biochemistry (Fall)	4	
		4510	Protein Chemistry (Spring)	4	
		4520	Enzymology (Spring)	4	
		4530	Nucleic Acid Chemistry (Spring)	4	
		4580	Bioinorganic Chemistry (Spring)	4	
				Multicultural Course US Diversity	
				***	
			Humanities/ Fine Arts Core Elective II	3	***
				16	
<b>Eight</b>					
			Social Science Elective	3	***
			Multicultural Course, Non Western	3	***
			Writing Across the Curriculum	3	***



Choose One Course +	CHEM	3720	Physical Chemistry For the Life Sciences II (Spring)	3	***
		3860	Advanced Laboratory I (WAC) (Fall)	2	
		4500	Advanced Biochemistry (Fall)	4	
		4510	Protein Chemistry (Spring)	4	
		4520	Enzymology (Spring)	4	
		4530	Nucleic Acid Chemistry (Spring)	4	
		4580	Bioinorganic Chemistry (Spring)	4	
			Elective(s)-to get to 124 hours	6	***
				16	***
*** See course catalog for pre- and co-requisites + listed twice because courses offered in different semesters; only need one course					
FL Foreign language to be decided by student and adviser.					
Courses which satisfy the College and University degree requirements can be determined by running a degree audit and looking at the list of courses presented as satisfying the requirement. Always try to take courses in which you have an interest.					

### Comments on BA in Biochemistry Curriculum:

35 hours of CHEM courses are required. The following courses must be included: CHEM 1230, 1240, 1280, 1290, 2410, 2420, 2460, 2470, 3310, 3360, 3510, 3520, 3560, either 3710 or 4570, and one additional course from CHEM 3860, 3720, 4500, 4510, 4520, 4530, or 4580. The following related courses are required: MATH 1750 or 1830 or 1850, MATH 1760 or 1840 or 1860; PHYS 2070 and 2080; BIOL 2170 and 3030.

### For the bachelor of science degree in chemistry

TERM	SUBJECT	NUMBER	COURSE TITLE	CR HR		REQUIREMENTS
<b>First</b>						
	CHEM	1230	General Chemistry I	4	17	***
	CHEM	1280	General Chemistry Lab I	1		***
	MATH	1830 or 1850	Calculus I For Mathematicians, Scientists And Educators or Single Variable Calculus I	4		***
	ENGL	1110	College Composition I	3		***
	NSM	1000	Orientation	2		***
			Humanities/Fine Arts Core Elective	3		***
<b>Second</b>						
	CHEM	1240	General Chemistry II	4	16	***
	CHEM	1290	General Chemistry Lab II	1		***
	MATH	1840 or 1860	Calculus II For Mathematicians, Scientists And Educators or Single Variable Calculus II	4		***
	CHEM	1910	Survey of Research	1		***
	ENGL	1130	College Composition II	3		***
			Social Science Core Elective	3		***



<b>Third</b>						
	CHEM	2410	Organic Chemistry I	3	16	***
	CHEM	2480	Organic Separations And Elementary Synthesis	2		***
	CHEM	3310	Analytical Chemistry	2		***
	MATH	2850	Elementary Multivariable Calculus	4		***
	PHYS	2130	Physics For Science And Engineering Majors I	5		***
<b>Fourth</b>						
	CHEM	2420	Organic Chemistry II	3	15	***
	CHEM	2490	Synthesis And Identification Of Organic Compounds	2		***
	CHEM	3360	Analytical Chemistry Laboratory-WAC	2		***
			Humanities/ Fine Arts Elective	3		***
	PHYS	2140	Physics For Science And Engineering Majors II	5		***
<b>Fifth</b>						
	CHEM	3730	Physical Chemistry I	3	16	***
	CHEM	3860	Advanced Laboratory I-WAC	2		***
	CHEM	3510	Biochemistry I	3		***
	CHEM	3910	Undergraduate Research II	2		
			Social Science Core Elective	3		***
			Multicultural Course, Non Western	3		
						***
<b>Sixth</b>						
	CHEM	3740	Physical Chemistry II	3	16	***
	CHEM	3870	Advanced Laboratory II	2		***
	CHEM	3910	Undergraduate Research II	2		
	CHEM	3610	Inorganic I	3		***
			Multicultural Course, US Diversity	3		***
			Elective-to reach 124 hours	3		***
<b>Seventh</b>						
	CHEM	4300	Instrumental Analysis	2	15-16	***
	CHEM	4880	Advanced Laboratory III	2		***
	CHEM	4910	Undergraduate Research III	2		
			Choose from: BIOL 2150; BIOL 2170; EEES 2010, EEES 2100, EEES 2150	3/4		***
			Elective-to reach 124 hours	3		***
			Elective-to reach 124 hours	3		if 14 must take 16 in term8
<b>Eight</b>						
	CHEM	4910	Undergraduate Research III	2	14	
			Elective-to reach 124 hours	2		
			Elective-to reach 124 hours	3		
			Elective-to reach 124 hours	3		
			Elective-to reach 124 hours	4		

\*\*\* See course catalog for pre- and co-requisites

Electives without recommendations are to be determined by the student using Banner Degree Audit program to determine which courses fulfill requirements and then by student interest.of courses presented as satisfying the requirement.

## Comments on BS in Chemistry Curriculum:

44 hours of CHEM courses are required. The following courses must be included: CHEM 1230, 1240, 1280, 1290, 2410, 2420, 2480, 2490, 3310, 3360, 3510, 3610, 3730, 3740, 3860, 3870, 4300 and 4880. Optional advanced chemistry courses include any other 3000 or 4000 level CHEM courses except CHEM 3712, 3722, 3732, 3742, 3910, 3920, or 4920. The following related courses are required: MATH 1830 or 1850, MATH 1840 or 1860 and 2850; and PHYS 2130 and 2140. A minimum cumulative GPA of 2.5 in chemistry is required for graduation with this degree.

## For the Bachelor of Science degree in biochemistry

		COURSE		CR		COURSE	
TERM	SUBJECT	NUMBER	COURSE TITLE	HR		REQUIREMENTS	HOURS
<b>First</b>							
	CHEM	1230	General Chemistry I	4		***	
	CHEM	1280	General Chemistry Lab I	1		***	
	MATH	1750 or 1830 or 1850	Calculus For The Life Sciences With Applications I or Calculus I For Mathematicians, Scientists And Educators or Single Variable Calculus I	4		***	
	ENGL	1110	College Composition I	3		***	
	NSM	1000	Orientation	2		***	
			Humanities/Fine Arts Core Elective	3		***	16
<b>Second</b>							
	CHEM	1240	General Chemistry II	4		***	
	CHEM	1290	General Chemistry Lab II	1		***	
	CHEM	1910	Survey of Research	1			
	MATH	1760 or 1840 or 1860	Calculus For The Life Sciences With Applications II or Calculus II For Mathematicians, Scientists And Educators or Single Variable Calculus II	3 or 4		***	
	ENGL	1130	College Composition II	3		***	
			Social Science Core Elective	3		***	15 or 16 (if 15, may take 1 less hour in a future semester)
<b>Third</b>							
	CHEM	2410	Organic Chemistry I	3		***	
	CHEM	2480	Organic Separations And Elementary Synthesis	2		***	
	CHEM	3310	Analytical Chemistry	2		***	
	PHYS	2070 or 2130	General Physics I or Physics For Science And Engineering Majors I	5		***	
			Humanities/Fine Arts Core Elective	3		***	15
<b>Fourth</b>							
	CHEM	2420	Organic Chemistry II	3		***	
	CHEM	2490	Synthesis And Identification Of Organic Compounds	2		***	
	CHEM	3360	Analytical Chemistry Laboratory-WAC	2		***	
			Social Science Core Elective	3		***	
	PHYS	2080 or 2140	General Physics II or Physics For Science And Engineering Majors II	5		***	15

<b>Fifth</b>							
	BIOL	2170	Fundamentals of Life Science:: Biomolecules, Cells, and Inheritance	4		***	
	CHEM	3510	Biochemistry I	3		***	
			Multicultural-US Diversity	3		***	
			Elective-to get to 124 hours	3			
			Elective(s)-to get to 124 hours	3		***	16
<b>Sixth</b>							
	CHEM	3560	Biochemistry Laboratory	2		***	
	CHEM	3520	Biochemistry II	3		***	
	CHEM	3610	Inorganic Chemistry I	3		***	
	BIOL	3030	Cell Biology	3			
			Multicultural-Non-Western	3			14
<b>Seventh</b>							
	CHEM	4570	Biophysical Chemistry	4		***	
	CHEM	3860	Advanced Laboratory I-WAC	2			
	CHEM	4300	Instrumental Analysis	2		***	
<b>Choose one</b>	CHEM	3910	Undergraduate Research II	2		<b>Choose one</b>	
		4910	Undergraduate Research III	2			
		4880	Advanced Laboratory III	2			
			Elective-to get to 124 hours	3			
			Elective- to get to 124 hours or choose one from below	4			
<b>Choose One +</b>	CHEM	4500	Advanced Biochemistry	4	F	<b>Choose One +</b>	
		4510	Protein Chemistry	4	S		
		4520	Enzymology	4	S		
		4530	Nucleic Acid Chemistry	4	S		
		4580	Bioinorganic Chemistry	4	S		
		4980	Special Topics in Chemistry	4	F,S		17
<b>Eight</b>							
			Elective-to get to 124 hours	3			
			Elective-to get to 124 hours	3			
			Elective-to get to 124 hours	3			
			Elective-to get to 124 hours	2			
			Elective-to get to 124 hours or choose one from below	4			
<b>Choose One +</b>	CHEM	4500	Advanced Biochemistry	4	F	<b>Choose One +</b>	
		4510	Protein Chemistry	4	S		
		4520	Enzymology	4	S		
		4530	Nucleic Acid Chemistry	4	S		
		4580	Bioinorganic Chemistry	4	S		
		4980	Special Topics in Chemistry	4	F,S		16
*** See course catalog for pre- and co-requisites + listed twice because courses offered in different semesters only need one course							
Courses which satisfy the College and University degree requirements can be determined by running a degree audit and looking at the list of courses presented as satisfying the requirement. Always try to take courses in which you have an interest.							
			credits	124			

### Comments on BS in Biochemistry Curriculum:

49 hours of CHEM courses are required. The following courses must be included: CHEM 1230, 1240, 1280, 1290, 2410, 2420, 2480, 2490, 3310, 3360, 3510, 3520, 3560, 3610, 3860,

4300 and 4570. The advanced laboratory requirement will be met by either CHEM 3910 (2 hours), 4880 or 4910 (2 hours). One advanced biochemistry course must be selected from: CHEM 4500, 4510, 4520, 4530, 4580 and 4980. The following related courses are required: MATH 1750 or 1830 or 1850, MATH 1760 or 1840 or 1860; PHYS 2070 or 2130, PHYS 2080 or 2140; and BIOL 2170 and 3030. A minimum cumulative GPA of 2.5 in chemistry is required for graduation with this degree.

The Bachelor of Science degree programs meet the minimum standard of the American Chemical Society as specified by its Committee on Professional Training, so that the degree recipients are certified by the American Chemical Society and are eligible for full membership in the society.

The Department of Chemistry and Biochemistry strongly advises students who wish to enroll in 3000- or 4000-level courses to earn minimum grades of C in prerequisite courses. Students pursuing a chemistry or biochemistry major may not elect the P/NC option in major or related courses, or prerequisites for these courses, except as noted in specific course descriptions.

### **Experience in Research**

The department offers experience in research under faculty guidance at all levels, in CHEM 2910, 3910 and 4910. Students are encouraged to talk with faculty members about research participation and to consult with more than one faculty member about appropriate projects. A student who wishes to participate in research should obtain the consent of a faculty member who agrees to guide this work and the approval of a departmental undergraduate adviser before the first day of the first semester that he/she enrolls for CHEM 2910, 3910 or 4910. Students may enroll in the different courses, CHEM 2910, 3910 and 4910, with different faculty members.

### **Minor in Chemistry**

The minor in chemistry is designed to complement the objectives of students in a variety of majors. A minimum of 22 hours of chemistry courses and a minimum GPA of 2.0 in those courses are required for the minor in chemistry. No courses in the minor may be taken P/NC except CHEM 4920. The following courses must be included: CHEM 1230, 1240, 1280, 1290, 2410, 2420, 2460 and 2470 (or 2480 and 2490). For the minor in chemistry, additional courses may include any 3000 or 4000 level CHEM course except CHEM 3712, 3722, 3732, 3743, 3910, 3920 or 4910. MBC 3550 and 3560 may be substituted for CHEM 3510 and 3520.

### **Honors in Chemistry**

**Qualified students may be invited to work for the citation “honors in chemistry or biochemistry.”**

**A. Admission:** The honors program is open to all chemistry or biochemistry majors studying toward the B.S. degree and to other students with the consent of the departmental honors adviser and the Chair of the department. The program may be undertaken concurrently with University Honors. Admission to the departmental Honors Program is based on academic standing, recommendations by instructors and an interview with the departmental honors adviser. A minimum overall GPA of 3.3 and a minimum GPA of 3.5 in chemistry course work are required for admission and to maintain good standing in the honors program. Any student may petition the departmental honors adviser for admission to the program. A student should normally begin the program no later than the end of the sophomore year.

**B. Requirements:** In addition to the credits required to complete the major, each honors student must satisfactorily complete CHEM 4910, independent research, with a written thesis and an oral research report upon completion of the research project. A minimum of six hours of the required chemistry courses at the 3000 and 4000 levels, in addition to CHEM 4910, must be taken for honors. These courses must be in at least two different areas of chemistry, to be selected from among analytical chemistry, biochemistry, inorganic chemistry, organic chemistry

and physical chemistry. The instructor in each of these courses will plan activities above the normal requirements of the course for the honors student, in line with the aims of the Honors Program, to encourage independent scholarship. Outside reading and writing may be important components of each Honors course assignment. Students enrolled in the departmental Honors Program also are encouraged to participate in the department's colloquium program. In order to graduate with departmental honors, a minimum overall GPA of 3.3 and a minimum GPA of 3.5 in chemistry course work must be earned.

### Junior Year Studies in England for Chemistry and Biochemistry Majors

The University of Toledo has an exchange program agreement with the University of Salford, England. Selected UT students spend their junior years at Salford, and students in the Salford three-year chemistry honors program spend their second year at UT. Eligibility is based on scholastic standing. Participants in the program pay their instructional and general fees to their home institutions. Information on the program may be obtained from the departmental international exchange adviser or from Dr. Brian Ashburner, Director of the UT-Salford Exchange Program.

### Department of Environmental Sciences

Timothy G. Fisher, Chair, Professor,  
 Johan F. Gottgens, Associate Chair, Professor, undergraduate adviser (BIOM)  
 Alison L. Sponberg, undergraduate adviser (environmental studies)  
 James Martin-Hayden, undergraduate adviser (environmental sciences)  
 Jonathan M. Bossenbroek, Honors research adviser  
 Mark J. Camp, undergraduate adviser (environmental sciences)  
 Von Sigler, undergraduate adviser (environmental sciences, 3+2)  
 Richard Becker, undergraduate adviser (geology)  
 Scott Heckathorn, undergraduate adviser (environmental sciences)

### Degrees Offered

The Department of Environmental Sciences offers degree programs for a bachelor of arts in environmental studies, a bachelor of science in environmental science, a bachelor of arts and a bachelor of science in geology, and a bachelor of science in biology with a concentration in ecology and organismal biology (BIOM). <http://www.utoledo.edu/nsm/envsciences/undergrad/>

### Requirements for the Bachelor of Arts Degree in Environmental Studies (ENST)

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COMMENTS
<b>First Term</b>					
	NSM	1000	ORIENTATION	2	
	ENGL	1110	COMP I	3	
	CHEM	1090	ELEMENTARY CHEMISTRY	3	or CHEM 1100 or 1230
	EEES	2010	INTRO TO ENV. STUDIES	3	
			FOREIGN LANGUAGE I	4	
			15		
<b>Second Term</b>					
	EEES	2100	FUND. OF GEOLOGY	4	
	EEES	1020	GEOLOGY LAB	1	
	ENGL	1130-1150	COMP II	3	
			FOREIGN LANGUAGE II	4	
			CORE HUMANITIES I	3	
			15		
<b>Third Term</b>					

	EEES	3100	SURFICIAL PROCESSES	3
	GEPL	3900	ENVIRONMENTAL PLANNING	3
			GENERAL ELECTIVE	3
	EEES	2500	COMP. IN ENV. SCIENCE	1
			CORE HUMANITIES II	3
			COLLEGE or CORE SCIENCE	3
				16
<b>Fourth Term</b>				
	EEES	2150	BIODIVERSITY	4
	EEES	2160	BIODIVERSITY LAB	1
	MATH	2600 or 2640	STATISTICS	3
			CORE SOCIAL SCIENCE I	3
			CORE SOCIAL SCIENCE II	3
			COLLEGE HUMANITIES-HISTORY	3
				17
<b>Fifth Term</b>				
	EEES	3050	INTRO ECOLOGY	3
	PHIL	3180	ENV. ETHICS	3
			CONCENTRATION COURSE	3
			CONCENTRATION COURSE	3
	PSC	4340	ENV. POLICY	3
				15
<b>Sixth Term</b>				
			US DIVERSITY	3
			CONCENTRATION COURSE	3
			CONCENTRATION COURSE	3
			COLLEGE HUMANITIES-ENG LIT	3
			NON-WESTERN	3
				15
<b>Seventh Term</b>				
			CONCENTRATION COURSE	3
	EEES	4940	INTERNSHIP	0to3
			WAC	3
			COLLEGE HUMANITIES-FINE ARTS	3
			CONCENTRATION COURSE	3
			CONCENTRATION COURSE	3
				15-18
<b>Eighth Term</b>				
	EEES	3900	EEES WAC	3
	ECON	3240	ENV ETHICS	3
	EEES	4970	CAPSTONE	3
			COURSES TO REACH 124 HOURS	5to8
				14-17
			<b>Total Earned Credit Hours</b>	<b>124</b>

or EEES 2400 or 4240

or courses to reach 124 hours

If 17, may take 1 less hour in future semester

F

internship req. course credit is optional

hours depend on hours taken in 7th semester

## Bachelor of Science Degree in Environmental Sciences (ENSC)

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COURSE REQUIREMENTS	COMMENTS
<b>First Term</b>						
	NSM	1000	ORIENTATION	2	major requirement	
	EEES	2010	INTRO ENVIRONMENTAL STUDIES	3	major requirement	
	CHEM	1230	GENERAL CHEMISTRY I	4	major requirement	
	CHEM	1280	GENERAL CHEMISTRY I LAB	1	major requirement	
	ENGL	1110	COLLEGE COMP I	3	general education	
			SOCIAL SCIENCE CORE	3	general education	
				16		
<b>Second Term</b>						
	CHEM	1240	GENERAL CHEMISTRY II	4	major requirement	
	CHEM	1290	GENERAL CHEMISTRY II LAB	1	major requirement	
	EEES	2150	BIODIVERSITY	4	major requirement	
	EEES	2160	BIODIVERSITY LAB	1	coreq. EEES2150, major requirement	
	EEES	1020	GEOLOGY LAB	1	major requirement	
	EEES	2100	FUNDAMENTALS OF GEOLOGY	4	major requirement	
				15		
<b>Third Term</b>						
	EEES	3050	GENERAL ECOLOGY	3	EEES or BIOL 2150, major requirement	
	EEES	3060	ECOLOGY LAB	1	coreq. 3050, major requirement	
	MATH	1750 or 1850	CALCULUS I	4	major requirement	
	ENGL	1130	COLLEGE COMP II	3	general education	
	EEES	2500	COMPUTERS IN ENV. SCI.	1	EEES1010 or 2100, major requirement	
	EEES	3100	SURFICIAL GEOLOGY*	3	EEES 2100, major requirement	*May take EEES 2400, 3100, or 4240
				15		
<b>Fourth Term</b>						
	PHIL	3180	ENVIRONMENTAL ETHICS	3	major requirement	
	MATH	1760 or 1860	CALCULUS II	3-4	major requirement	
			SCIENCE OR MATH outside major	3	major elective	
			WAC COURSE	3	elective	
	EEES		ENSC CONCENTRATION*	3	major requirement	
				15-16		

<b>Fifth Term</b>					
	PSC	4340	ENVIRONMENTAL POLICY	3	major requirement
	MATH	2640	STATISTICS FOR APPLIED SCIENCE	3	major requirement
	GEPL	3900	ENVIRONMENTAL PLANNING	3	major requirement
	EEES		ENSC CONCENTRATION*	6	major requirement
			HUMANITIES CORE	3	general education
				18	
<b>Sixth Term</b>					
			US DIVERSITY CORE	3	general education
	EEES		ADVANCED LAB	1	major requirement
	EEES	2510	ADV COMPUTERS IN ENV. SCI.	2	
			HUMANITIES CORE	3	general education
			ENSC CONCENTRATION*/ ELECTIVES TO GET TO 124 HOURS	3	
			SOCIAL SCIENCE CORE	3	elective
				15	
<b>Seventh Term</b>					
	ECON	3240	ENVIRONMENTAL ECONOMICS	3	major requirement
	EEES	4940	INTERNSHIP	0-3	major requirement
			ENSC CONCENTRATION* OR ELECTIVES TO GET TO 124 HOURS	5	elective
			ENSC CONCENTRATION	4	major requirement
			NON-WESTERN CORE	3	general education
				15-18	
<b>Eighth Term</b>					
	EEES	3900	ENVIRON. LIT. & COMM. WAC	3	Junior or Senior standing, major requirement
	EEES	4970	SENIOR ENVIRONMENTAL CAPSTONE	3	major requirement
			ENSC CONCENTRATION* OR ELECTIVES TO GET TO 124 HOURS	9	elective
				15	
			<b>Total Earned Credit Hours</b>	<b>124</b>	

Internship is required. May take for 0 to 3 hours.

### Comments on BA in ENST and BS in ENSC :

All students in the B.A. and B.S. programs must complete the following courses: EEES 1020, 2010, 2100, 2150, 2160, 2500, 3050, 3100 (or 2400 or 4240), 3900 and 4970, as well as MATH 2640, PSC 4340, ECON 3240 (or 3270), GEPL 3900 and PHIL 3180. Prerequisites will be waived for environmental studies (ENST) and environmental sciences (ENSC) majors enrolling in these last four courses.

All environmental studies and environmental sciences students also will select an area of concentration in an academic department within the College of Natural Sciences and



Mathematics and College of Arts and Letters. Students must complete at least 21 hours of course work in their area of concentration. Qualified environmental sciences majors may elect a track in environmental health and continue for a 5th year to earn an M.S. in Public Health or in Occupational Health from the University's College of Health and Human Services. Students also are required to complete a 100-hr environment-related internship (EEES 4940) in an agency, corporation, university laboratory or other approved location. With the exception of EEES 4940, students may not take any courses required in the major as P/NC.

In addition to the above requirements, students in the B.S. program must also complete the following: EEES 2510, 3060 and 1 advanced lab; CHEM 1230, 1240, 1280 and 1290; and MATH 1750 and 1760 or MATH 1850 and 1860. Students in the B.A. program also must take CHEM 1090 or 1100. Students choosing a concentration in economics must complete either MATH 1320 and 1330, or MATH 1340, or MATH 1750 and 1760.

### **Public Health Track**

This track requires the student to maintain an overall GPA of 3.0 or higher during the first 2 years of university study. The student normally will apply at the end of the sophomore year (year 2). In addition to the courses listed above, students electing this concentration take CHEM 2410 (Organic Chemistry I) during the junior year (year 3) and take the following graduate courses during their senior year (year 4): PUBH 6000 (Public Health Statistics), PUBH 6640 (Issues in Public Health), PUBH 6010 (Public Health Epidemiology) and PUBH 6600 (Health Behavior). If students maintain a 3.0 average in these 4 courses and their overall GPA, these students will be able to use these 12 credits toward the Master of Public Health Degree and should be able to complete BOTH the BS in Environmental Science and the MPH degrees in 5 years. Students interested in the Master of Science in Occupational Health degree rather than the MPH should also take PHYS 1750 (Introduction to Physics) during the fourth year as an undergraduate elective.

### **Minor in Environmental Sciences**

Students electing to minor in environmental sciences must complete at least 21 hours of course work consisting of EEES 2010, 2100, 2150, 2400, and at least six additional hours of EEES course work listed at 3000 or 4000 level. In addition, at least one, one-hour EEES laboratory course is required. A minimum GPA of 2.0 in the EEES course work is required, and the program must be approved in advance by a departmental ENSC Adviser.

### **Junior Year Studies at the University of Hertfordshire in England for Environmental Studies/Sciences Majors**

The College of Natural Sciences and Mathematics of The University of Toledo participates in an exchange program with the University of Hertfordshire, England. Selected UT students have the opportunity to spend their junior year at Hertfordshire. Participants in the program will pay their instructional and general fees to The University of Toledo. Eligibility to participate in the program is based on scholastic criteria. Information on the program may be obtained from the departmental exchange program Adviser (W. Von Sigler). Details are available on academic issues, living accommodations, recreational opportunities and life in England.

### **Junior Year Studies at the University of Salford in England for Environmental Sciences and Biology Majors**

Selected UT students in the Department of Environmental Sciences have the opportunity to spend their junior year at Salford. Participants in the program will pay their instructional and general fees to The University of Toledo. Eligibility to participate in the program is based on criteria established by the Department of Environmental Sciences. Information on the program may be obtained from the departmental exchange program Adviser (W. Von Sigler) or from Dr. Brian Ashburner, Director of the UT-Salford Exchange Program. Details are available on academic issues, living accommodations, recreational opportunities and life in England on the departmental Web site at <http://www.utoledo.edu/nsm/bio/salford/>

## Requirements for the Bachelor of Science Degree in Geology

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COMMENTS
<b>First Term</b>					
	NSM	1000	ORIENTATION	2	
	EEES	2100	FUND OF GEOLOGY	4	
	EEES	1020	GEOLOGY LAB	1	
	ENGL	1110	COMP I	3	
			CORE SOCIAL SCIENCE I	3	
			CORE HUMANITIES I	3	
				<b>16</b>	
<b>Second Term</b>					
			CORE SOCIAL SCIENCE II	3	
	EEES	2230	EARTH HISTORY	3	
	ENGL	1130-1150	COMP II	3	
			CORE HUMANITIES II	3	
	CHEM	1230	GEN CHEMISTRY I	4	
	CHEM	1280	GEN CHEMISTRY I LAB	1	
				<b>17</b>	
<b>Third Term</b>					
	EEES	3210	EARTH MATERIALS I	3	
	MATH	1750	CALCULUS I	4	Or MATH 1830 or 1850
	CHEM	1240	GEN CHEMISTRY II	4	
	CHEM	1290	GEN CHEMISTRY II LAB	1	
	EEES	2500	COMP IN ENV SCIENCE	1	
			US DIVERSITY	3	
				<b>16</b>	
<b>Fourth Term</b>					
	EEES	3220	EARTH MATERIALS II	3	
	MATH	1760	CALCULUS II	3	Or Math 1840 or 1850
	EEES	2510	ADV COMP IN ENV SCIENCE	2	
			NON-WESTERN	3	
			WAC	3	
				<b>14</b>	
<b>Fifth Term</b>					
	EEES	3310	STRUCTURAL GEOLOGY	3	
			ONE COURSE FROM: EEES 2400,3100,4100,4200,4240	3	
			ONE COURSE FROM EEES 4150,4220,4410,4450,4490,4610	3	
	PHYS	2070	GEN PHYSICS I	5	
				<b>14</b>	
<b>Sixth Term</b>					
			ONE COURSE FROM: EEES 2400,3100,4100,4200,4240	3	
	PHYS	2080	GEN PHYSICS II	5	
			COURSES TO REACH 124 HOURS	9	
				<b>17</b>	
<b>Seventh Term</b>					
			ONE COURSE FROM: EEES 4150, 4220,4410,4450,4490,4610	3	
	EEES	4640	APPLIED GEOLOGY	2	
			COURSES TO REACH 124 HOURS	10	
				<b>15</b>	
<b>Eighth Term</b>					

			ONE COURSE FROM: EEES 2400, 3100, 4100, 4200, 4240, 4150, 4220,4410,4450,4490,4610	3
	EEES	4640	APPLIED GEOLOGY	1
	EEES	4920	SENIOR GEOLOGY	2
			COURSES TO REACH 124 HOURS	9
				<b>15</b>
			<b>Total Earned Credit Hours</b>	<b>124</b>

### Comments on BS in Geology Curriculum:

The Bachelor of Science degree in geology requires a minimum of 40 hours in the major, including the following: EEES 1020, 2100, 2230, 2500, 2510 or 4480, 3210, 3220, 3310, 4650 (3 hours), 4920. An additional 5 electives with at least 2 from each group is required. Group A: EEES 2400, 3100, 4100, 4240; 4480; Group B: 4150, 4220, 4410, 4450, 4490, 4610. In addition, the following related courses are required: MATH 1850 and 1860 or MATH 1750 and 1760; CHEM 1230, 1240, 1280, and 1290; and PHYS 2070 and 2080 or PHYS 2130 and 2140. Students must achieve a minimum GPA of 2.5 in the major to graduate. Students may not take any required course in the major or related areas as P/NC.

### Requirements for the Bachelor of Arts Degree in Geology

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COMMENTS
<b>First Term</b>					
	NSM	1000	ORIENTATION	2	
	EEES	2100	FUND OF GEOLOGY	4	
	EEES	1020	GEOLOGY LAB	1	
	ENGL	1110	COMP I	3	
			FOREIGN LANGUAGE I	4	
			CORE HUMANITIES I	3	
				17	
<b>Second Term</b>					
	EEES	2500	COMP IN ENV SCIENCE	1	
	EEES	2230	EARTH HISTORY	3	
	ENGL	1130-1150	COMP II	3	
			FOREIGN LANGUAGE II	4	
	CHEM	1230	GEN CHEMISTRY I	4	
	CHEM	1280	GEN CHEMISTRY I LAB	1	
				16	
<b>Third Term</b>					
	EEES	3210	EARTH MATERIALS I	3	
	MATH	1320	COLLEGE ALGEBRA	3	
			RELATED FIELDS SCIENCE	3	
			CORE HUMANITIES II	3	
			CORE SOCIAL SCIENCE I	3	
				15	If 16, take 15 next semester. If 15, take 16 next semester.
<b>Fourth Term</b>					
	EEES	3220	EARTH MATERIALS II	3	
			ONE COURSE FROM: EEES 2400,3100,4100,4200,4240	3	
			CORE SOCIAL SCIENCE II	3	

			RELATED FIELDS SCIENCE	3to4
	MATH	1330	TRIG	3
				15-16
<b>Fifth Term</b>				
	EEES	3310	STRUCTURAL GEOLOGY	3
			ONE COURSE FROM: EEES 2400,3100,4100,4200,4240	3
			COLLEGE HUMANITIES-ENG LIT	3
			COLLEGE SOCIAL SCIENCE	3
			RELATED FIELDS SCIENCE	3to4
				15-16
<b>Sixth Term</b>				
			US DIVERSITY	3
			COLLEGE HUMANITIES-FINE ARTS	3
			ONE COURSE FROM: EEES 2400,3100,4100,4200,4240	3
			COLLEGE HUMANITIES- HISTORY	3
			ONE COURSE FROM: EEES 4150, 4220,4410,4450,4490,4610	3
				15
<b>Seventh Term</b>				
			ONE COURSE FROM: EEES 4150, 4220,4410,4450,4490,4610	3
			WAC	3
	EEES	4640	APPLIED GEOLOGY	2
			COURSES TO REACH 124 HOURS	8
				16
<b>Eighth Term</b>			ONE COURSE FROM: EEES 4150, 4220,4410,4450,4490,4610	3
	EEES	4640	APPLIED GEOLOGY	1
	EEES	4920	SENIOR GEOLOGY	2
			NON-WESTERN	3
			COURSES TO REACH 124 HOURS	6
				15
			Total Earned Credit Hours	<b>124</b>

If 16, may take one less course in future semester.



### Comments on BA in Geology Curriculum

The Bachelor of Arts degree in geology requires a minimum of 41 hours in the major. All students must complete the following: EEES 1020, 2100, 2230, 2500, 3210, 3220, 3310, 4650 (3 hours), 4920 as well as 3 courses from Group A (EEES 2400, 3100, 4100, 4240, 4480 or 2510) and 3 courses from Group B (4150, 4220, 4410, 4450, 4490, 4610). In addition, students must complete MATH 1340 or MATH 1320 and 1330 or an approved higher level math course; CHEM 1230 and 1280; and nine hours of approved electives in astronomy, biology (including EEES ecology courses), chemistry, engineering, geography and planning and/or physics. This degree is designed to give students greater flexibility in designing a program of study tailored to their specialized interests in geology and the related sciences. Students must achieve a

minimum GPA of 2.0 in the major to graduate. Students may not take any required course in the major or related areas as P/NC.

### Minor in Geology

Students electing to minor in geology must complete EEES 1020, 2100, 2230, 2500, 3100, 3210, 3220, 3310, and one additional formal 3000-4000 level geology course. The departmental undergraduate Adviser must approve a program of study in advance, and a minimum GPA of 2.0 must be achieved for the course work completed in the minor.

### Requirements for the Bachelor of Science Degree in Biology with a concentration in Ecology and Organismal Biology

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COMMENTS
<b>First Term</b>					
	NSM	1000	ORIENTATION	2	
	ENGL	1110	COMP I	3	
	CHEM	1230	GEN CHEMISTRY I	4	
	CHEM	1280	GEN CHEMISTRY I LAB	1	
			CORE SOCIAL SCIENCE I	3	
			CORE HUMANITIES I	3	
				16	
<b>Second Term</b>					
	EEES	2150	BIODIVERSITY	4	
	EEES	2160	BIODIVERSITY LAB	1	
	CHEM	1240	GEN CHEMISTRY II	4	
	CHEM	1290	GEN CHEMISTRY II LAB	1	
			CORE SOCIAL SCIENCE II	3	
	ENGL	1130-1150	COMP II	3	
				16	
<b>Third Term</b>					
	BIOL	2170	FUND OF LIFE SCIENCE CELLS	4	
	CHEM	2410	ORGANIC CHEMISTRY I	3	
	CHEM	2460	ORGANIC CHEMISTRY I LAB	1	
	MATH	1750	CALCULUS I	4	
			CORE HUMANITIES II	3	
				15	
<b>Fourth Term</b>					
	MATH	1760	CALCULUS II	3	
	CHEM	2420	ORGANIC CHEMISTRY II	3	
	BIOL	3010	MOLECULAR GENETICS	3	



			COURSES TO REACH 124 HOURS	6
				15
<b>Fifth Term</b>				
	EEES	3050	INTRO ECOLOGY	3
	EEES	3060	INTRO ECOLOGY LAB	1
	BIOL	3030	CELL BIOLOGY	3
			COURSES TO REACH 124 HOURS	3
			US DIVERSITY	3
			WAC	3
				16
<b>Sixth Term</b>				
			3000-4000 LEVEL EEES ELECTIVES	6
	MATH	2640	STATISTICS	3
			EEES ADVANCED LAB	1
			COURSES NEEDED TO REACH 124 HOURS	3
			COURSES NEEDED TO REACH 124 HOURS	3
				16
<b>Seventh Term</b>				
			3000-4000 LEVEL EEES ELECTIVES	6
			EEES ADVANCED LAB	1
	PHYS	2070	PHYSICS I	5
			NON-WESTERN	3
				15
<b>Eighth Term</b>				
	EEES	3900	EEES WAC	3
	EEES	4150	EVOLUTION	3

Choose from: EEES  
3800,4250,4300,4330,4510,4730  
,4740,4750,4760,4790,4940

Choose from: EEES  
4260,4550,4740,4770,3800,4000  
,4300,4330,4790,4800

Choose from: EEES  
3800,4250,4300,4330,4510,4730  
,4740,4750,4760,4790,4940

Choose from: EEES  
4260,4550,4740,4770,3800,4000  
,4300,4330,4790,4800



			EEES ADVANCED LAB	1
	PHYS	2080	PHYSICS II	5
				15
			<b>Total Earned Credit Hours</b>	<b>124</b>

Choose from: EEES  
4260,4550,4740,4770,3800,4000  
,4300,4330,4790,4800

### Comments on BS in Biology (BIOM) Curriculum

The Bachelor of Science degree in biology with a concentration in ecology and organismal biology (BIOM) requires a minimum of 27 hours in the major, including EEES 2150, 2160, 3050, 3060, 3900 and 4150. Twelve additional hours are required from EEES electives and must include at least three advanced laboratory courses (EEES 4250, 4260, 4510, 4550, 4730, 4740, 4750, 4760, 4790, 4910 or 4940, 4970, 4980). In addition, the following related courses are required: CHEM 1230, 1240, 1280, 1290, 2410, 2420 and 2460; PHYS 2070 and 2080 or 2130 and 2140; MATH 2640; and MATH 1750 and 1760 or 1830 and 1840 or 1850 and 1860; BIOL 2170, 3010, and 3030.

### Requirements for the Bachelor of Science Degree in Interdepartmental Studies with a concentration in Geophysics

The requirements for this degree, as approved by the three participating departments, are as follows: MATH 1850, 1860, 2850, 3860 (or 2860) and 1890 (18 credits); PHYS 2130, 2140, 3180, 4210 and 4230 (19 credits); and EEES 2100, 1020, 2500, 3210, 3220, 3310, 4610 and 4620 (or 4630) (21 credits). Students must also take an additional three to four hours of Adviser-approved electives at the 3000 or 4000 level from the mathematics, physics and astronomy, or environmental sciences departments to reach at least 60 hours. In addition, students must complete CHEM 1230 and 1280.

### Departmental Honors

Qualified sophomores, juniors and seniors working on degree programs within the department of environmental sciences may be invited to work for one of the following citations, consistent with their degree program: "honors in biology," "honors in environmental sciences," "honors in environmental studies" or "honors in geology."

**A. Admission:** The departmental Honors Program is open to all department majors and may be taken concurrently with College Honors. Admission to the departmental Honors Program is based on academic achievement. Normally, students invited to participate will have achieved a 3.3 or better overall GPA by the end of the sophomore year.

**B. Requirements:** A student must satisfactorily complete from three to six credits of EEES 4910 Directed Research and graduate with a minimum overall GPA of 3.3 in order to receive the honors citation. Candidates must prepare a written thesis based on their research and present an oral report at an open forum. Candidates also will provide two unbound copies of the approved thesis to the department for binding, one each for the research Adviser and department. This program provides an opportunity for the exceptional student to work closely with a faculty Adviser on an independent research topic. This research experience often leads to publication and is an excellent preparation for graduate studies.

## Department of Mathematics and Statistics

Don White, Professor, Chair

Alessandro Arsie, Associate Professor, Associate Chair

Geoffrey Martin, Associate Professor, Graduate Admissions Director

Nathaniel Iverson, Lecturer, Undergraduate Adviser

### Degrees Offered

The Department of Mathematics and Statistics offers a program for either a Bachelor of Arts or a Bachelor of Science degree.

### Advanced Placement

Students with a score of 3 or better on AB calculus will receive credit for MATH 1850. Students with a score of 3, 4 or 5 on the BC calculus test will receive credit for both MATH 1850 and 1860. Students with a score below 3 may be able to obtain credit by taking a departmental test. Students with a score of 3 or better on the Statistics Test will receive credit for MATH 2600.

### Degree Requirements, Bachelor of Science:

To obtain a Bachelor of Science degree in mathematics, students must complete MATH 1840 (or 1860), 1890 (or 2890), 2850 and 2190 (or 3190) and follow one of the following concentrations for a total of at least 38 hours.

#### 1. Pure Mathematics

- The following are required: MATH 2860, 4330, 4820, and 4880.
- One course must be completed from MATH 4300, 4450, or 4540.
- One course must be completed from MATH 4830 or MATH 4340.
- Two courses may be chosen from courses at the 3000 or 4000 level approved by the Adviser.

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COURSE REQUIREMENTS	Comments
<b>First Term</b>						
	NSM	1000	Orientation	2		
	MATH	1830	Calculus I For Mathematicians, Scientists And Educators	4	MATH 1340 Minimum Grade of C- or (MATH 1320 Minimum Grade of C- and MATH 1330 Minimum Grade of C-)	
	ENGL	1110	College Composition I	3		
			Core Natural Science I	3		
			Core Natural Science Lab	1		
			Core Social Science I	3		
				16		
<b>Second Term</b>						
	MATH	1840	Calculus II For Mathematicians, Scientists And Educators	4	MATH 1830 Minimum Grade of C- or MATH 1850 Minimum Grade of C- or MATH 1920 Minimum Grade of C-	
	ENGL	1130-1150	College Composition II	3		
			Core Natural Science (II)	3		
			Core Social Science II	3		



			Multicultural Courses (US Diversity )	3		
				16		
<b>Third Term</b>						
	MATH	2850	Elementary Multivariable Calculus	4	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-	
	MATH	3190	Introduction To Mathematical Analysis	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-	
			Multicultural Courses (Non-Western )	3		
			Core Humanities I	3		
			NSM Science Elective I	3		
				16		
<b>Fourth Term</b>						
	MATH	2860	Elementary Differential Equations	3	MATH 2850 Minimum Grade of C- or MATH 2950 Minimum Grade of C-	May take 3820 instead
	Math	3320	Into to Abstract Algebra		MATH 3190 Minimum Grade of C-	Recommended 3000/4000 elective
			NSM Science Elective II	3		
			Core Humanities II	3		
			Related Fields or courses needed to get to 124 hours	3		
				15		
<b>Fifth Term</b>						
	MATH	4330	Abstract Algebra I	3	MATH 3190 Minimum Grade of C-	
	MATH	1890	Elementary Linear Algebra	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-	May take 2890 instead
			NSM Science Elective III	4		
			Related Fields or courses needed to get to 124 hours	3		
			Related Fields or courses needed to get to 124 hours	3		
				16		
<b>Sixth Term</b>						

	MATH	4340	Abstract Algebra II	3	MATH 4330 Minimum Grade of C-	May take MATH 4830 instead
	MATH	4880	Complex Variables	3	MATH 3860 Minimum Grade of C- or MATH 3820 Minimum Grade of C-	
			Related Fields or courses needed to get to 124 hours	3		
			Related Fields or courses needed to get to 124 hours	3		
			WAC College Requirement	3		
				15		
<b>Seventh Term</b>						
	MATH	4820	Introduction To Real Analysis I	3	MATH 3190 Minimum Grade of C-	May take MATH 4300 or 4540 instead
	MATH	4450	Intro to Topology	3	MATH 3190 Minimum Grade of C-	
			Related Fields or courses needed to get to 124 hours	3		
			Related Fields or courses needed to get to 124 hours	3		
			Related Fields or courses needed to get to 124 hours	3		
				15		
<b>Eighth Term</b>						
			3000-4000 level Math Elective II	3		
			Related Fields or courses needed to get to 124 hours	3		
			Related Fields or courses needed to get to 124 hours	3		
			Related Fields or courses needed to get to 124 hours	3		
			Related Fields or courses needed to get to 124 hours	3		
				15		
			<b>Total Earned Credit Hours</b>	<b>124</b>		

## 2. Applied Mathematics

- The following are required: MATH 3320 (or 4330), 2860, 4300 (or 4350), and 4820 (or 4880).
- One of the following two-semester sequences must be completed: MATH 4710 and 4720 or 4740 and 4750.
- One course must be complete from MATH 3610, 4800, 4810 or 4860.
- One course may be chosen from courses at the 3000 or 4000 level approved by the Adviser.

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COURSE REQUIREMENTS	Comments
<b>First Term</b>						
	NSM	1000	Orientation	2		
	MATH	1830	Calculus I For Mathematicians, Scientists And Educators	4	MATH 1340 Minimum Grade of C- or (MATH 1320 Minimum Grade of C- and MATH 1330 Minimum Grade of C-)	
	ENGL	1110	College Composition I	3		
			Core Natural Science I	3		
			Core Natural Science Lab	1		
			Core Social Science I	3		
				16		
<b>Second Term</b>						
	MATH	1840	Calculus II For Mathematicians, Scientists And Educators	4	MATH 1830 Minimum Grade of C- or MATH 1850 Minimum Grade of C- or MATH 1920 Minimum Grade of C-	
	ENGL	1130-1150	College Composition II	3		
			Core Natural Science (II )	3		
			Core Social Science II	3		
			Multicultural Courses (US Diversity )	3		
				16		
<b>Third Term</b>						
	MATH	2850	Elementary Multivariable Calculus	4	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-	
	MATH	3190	Introduction To Mathematical Analysis	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-	
			Multicultural Courses (Non-Western )	3		
			Core Humanities I	3		

			NSM Science Elective I	3		
				16		
<b>Fourth Term</b>						
	Math	3320	Into to Abstract Algebra		MATH 3190 Minimum Grade of C-	May take Math 4330 instead in fall semester
	MATH	2860	Elementary Differential Equations	3	MATH 2850 Minimum Grade of C- or MATH 2950 Minimum Grade of C-	May take MATH 2860 or 3820 instead
			NSM Science Elective II	3		
			Core Humanities II	3		
			Related Fields or courses needed to get to 124 hours	3		
				15		
<b>Fifth Term</b>						
	MATH	1890	Elementary Linear Algebra	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-	
	MATH	4710	Methods Of Numerical Analysis I	3	MATH 2860 Minimum Grade of C- or MATH 3820 Minimum Grade of C-	May take MATH 4740 and 4750 sequence instead
			NSM Science Elective III	4		
			Related Fields or courses needed to get to 124 hours	3		
			Related Fields or courses needed to get to 124 hours	3		
				16		
<b>Sixth Term</b>						
	MATH	4720	Methods Of Numerical Analysis II	3	MATH 4720 Minimum Grade of C-	May take MATH 4740 and 4750 sequence instead
	MATH	4880	Complex Variables	3	MATH 2860 Minimum Grade of C- or MATH 3820 Minimum Grade of C-	May take MATH 4820 instead
			Related Fields or courses needed to get to 124 hours	3		
			Related Fields or courses needed to get to 124 hours	3		
			WAC College Requirement	3		

				15	
<b>Seventh Term</b>					
	MATH	4820	Introduction To Real Analysis I	3	MATH 3190 Minimum Grade of C-
			MATH 3610, 4680, 4800, 4810, or 4860	3	
			Related Fields or courses needed to get to 124 hours	3	
			Related Fields or courses needed to get to 124 hours	3	
			Related Fields or courses needed to get to 124 hours	3	
				15	
<b>Eighth Term</b>					
	MATH	4350	Applied Linear Algebra	3	MATH 1890 Minimum Grade of C- or MATH 2890 Minimum Grade of C-
			3000-4000 Level Math Elective	3	
			Related Fields or courses needed to get to 124 hours	3	
			Related Fields or courses needed to get to 124 hours	3	
			Related Fields or courses needed to get to 124 hours	3	
				15	
			<b>Total Earned Credit Hours</b>	<b>124</b>	

May take MATH 4300 instead

### 3. Statistics

- The following courses are required: MATH 3610, 3620, 4350, 4600 , 4610, 4680, and 4690.
- One more course may be chosen from courses at the 3000 or 4000 level approved by the Adviser.

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COURSE REQUIREMENTS
<b>First Term</b>					
	NSM	1000	Orientation	2	

	MATH	1830	Calculus I For Mathematicians, Scientists And Educators	4	MATH 1340 Minimum Grade of C- or (MATH 1320 Minimum Grade of C- and MATH 1330 Minimum Grade of C-)
	ENGL	1110	College Composition I	3	
			Core Natural Science I	3	
			Core Natural Science Lab	1	
			Core Social Science I	3	
				16	
<b>Second Term</b>					
	MATH	1840	Calculus II For Mathematicians, Scientists And Educators	4	MATH 1830 Minimum Grade of C- or MATH 1850 Minimum Grade of C- or MATH 1920 Minimum Grade of C-
	ENGL	1130-1150	College Composition II	3	
			Core Natural Science (II )	3	
			Core Social Science II	3	
			Multicultural Courses (US Diversity )	3	
				16	
<b>Third Term</b>					
	MATH	2850	Elementary Multivariable Calculus	4	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-
	MATH	3190	Introduction To Mathematical Analysis	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-
			Multicultural Courses (Non-Western )	3	

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			Core Humanities I	3	
			NSM Science Elective I	3	
				16	
<b>Fourth Term</b>					
	MATH	1890	Elementary Linear Algebra	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-
			Related Fields or courses needed to get to 124 hours	3	
			NSM Science Elective II	3	
			Core Humanities II	3	
			Related Fields or courses needed to get to 124 hours	3	
				15	
<b>Fifth Term</b>					
	MATH	3610	Statistical Methods I	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or 1930 Minimum Grade of C- or MATH 3190 Minimum Grade of C-
	MATH	4680	Introduction To Theory Of Probability	3	MATH 2850 Minium Grade of C-
			NSM Science Elective III	4	
			Related Fields or courses needed to get to 124 hours	3	
			Related Fields or courses needed to get to 124 hours	3	
				16	
<b>Sixth Term</b>					
	MATH	3620	Statistical Methods II	3	MATH 3610 Minimum Grade of C-

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	MATH	4690	Introduction To Mathematical Statistics	3	MATH 4680 Minimum Grade of C-
			Related Fields or courses needed to get to 124 hours	3	
			Related Fields or courses needed to get to 124 hours	3	
			WAC College Requirement	3	
				15	
<b>Seventh Term</b>					
	MATH	4600	Applications of Statistics I	3	MATH 4680 Minimum Grade of C-
			3000-4000 Level Math Elective	3	
			Related Fields or courses needed to get to 124 hours	3	
			Related Fields or courses needed to get to 124 hours	3	
			Related Fields or courses needed to get to 124 hours	3	
				15	
<b>Eighth Term</b>					
	MATH	4350	Applied Linear Algebra	3	MATH 1890 Minimum Grade of C- or MATH 2890 Minimum Grade of C-
	MATH	4610	Applications of Statistics II	3	
			Related Fields or courses needed to get to 124 hours	3	
			Related Fields or courses needed to get to 124 hours	3	
			Related Fields or courses needed to get to 124 hours	3	
				15	
			<b>Total Earned Credit Hours</b>	<b>124</b>	

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#### 4. Mathematics with Computer Science

- a. The following are required: MATH 2860, 4380, 4710, 3320 (or 4330), 4820 (or 4880), and 4350 (or 4390 or 4720).
- b. Two courses may be chosen from courses at the 3000 or 4000 level approved by the Adviser.
- c. A minimum total of 18 hours in related area courses should be taken from EECS 1100 to 4990. At least two of these courses should be from EECS 2550 or at the 3000 or 4000 level approved by the Adviser.

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COURSE REQUIREMENTS	COMMENTS
<b>First Term</b>						
	NSM	1000	Orientation	2		
	MATH	1830	Calculus I For Mathematicians, Scientists And Educators	4	MATH 1340 Minimum Grade of C- or (MATH 1320 Minimum Grade of C- and MATH 1330 Minimum Grade of C-)	
	ENGL	1110	College Composition I	3		
			Core Natural Science I	3		
			Core Natural Science Lab	1		
			Core Social Science I	3		
				16		
<b>Second Term</b>						
	MATH	1840	Calculus II For Mathematicians, Scientists And Educators	4	MATH 1830 Minimum Grade of C- or MATH 1850 Minimum Grade of C- or MATH 1920 Minimum Grade of C-	
	ENGL	1130-1150	College Composition II	3		
			Core Natural Science (II)	3		
			Core Social Science II	3		
			Multicultural Courses (US Diversity)	3		

				16		
<b>Third Term</b>						
	MATH	2850	Elementary Multivariable Calculus	4	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-	
	MATH	3190	Introduction To Mathematical Analysis	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-	
			Multicultural Courses (Non-Western )	3		
			Core Humanities I	3		
			NSM Science Elective I	3		
				16		
<b>Fourth Term</b>						

	MATH	2860	Elementary Differential Equations	3	MATH 2850 Minimum Grade of C- or MATH 2950 Minimum Grade of C-	May take MATH 2860 instead.
	Math	3320	Intro to Abstract Algebra		MATH 3190 Minimum Grade of C-	May take Math 4330 instead
			NSM Science Elective II	3		
			Core Humanities II	3		
			EECS elective	3		
				15		
<b>Fifth Term</b>						

					MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-	
	MATH	1890	Elementary Linear Algebra	3		
	MATH	4710	Methods Of Numerical Analysis I	3	MATH 2860 Minimum Grade of C- or MATH 3820 Minimum Grade of C-	
			NSM Science Elective III	4		
			EECS elective	3		
			Related Fields or courses needed to get to 124 hours	3		
				16		
<b>Sixth Term</b>						
	MATH	4720	Methods Of Numerical Analysis II	3	MATH 4710 Minimum Grade of C-	May take MATH 4350 or 4390 instead
	MATH	4880	Complex Variables	3	MATH 2860 Minimum Grade of C- or MATH 3820 Minimum Grade of C-	May take MATH 4820 instead
			EECS elective	3		
			Related Fields or courses needed to get to 124 hours	3		
			WAC College Requirement	3		
				15		
<b>Seventh Term</b>						
			3000-4000 Level Math Elective	3		
	MATH	4380	Discrete Structures And Analysis Of Algorithms	3	MATH 4330 or 3320 Minimum Grade of C-	
			EECS elective	3		

			EECS elective (2500 or 3000-4000 level)	3		
			Related Fields or courses needed to get to 124 hours	3		
				15		
<b>Eighth Term</b>						
			3000-4000 Level Math Elective	3		
			EECS elective (2500 or 3000-4000 level)	3		
			Related Fields or courses needed to get to 124 hours	3		
			Related Fields or courses needed to get to 124 hours	3		
			Related Fields or courses needed to get to 124 hours	3		
				15		
			<b>Total Earned Credit Hours</b>	<b>124</b>		

### 5. Actuarial Science

- The following courses are required: MATH 3610, 3620, 2860, 4620, 4680, 4690, 4760, and 4770.
- The related area courses should include the following list: ECON 1150, 1200; BUAD 1020, 2040, 2050, 3040; FINA 3600; INFS 3150.

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COURSE REQUIREMENTS	COMMENTS
<b>First Term</b>						
	NSM	1000	Orientation	2		
	MATH	1840	Calculus II For Mathematicians, Scientists And Educators	4	MATH 1340 Minimum Grade of C- or (MATH 1320 Minimum Grade of C- and MATH 1330 Minimum Grade of C-)	Actuarial Science students need to start in calculus II or may take Math 2850 in the summer. May substitute Math 1860
	ENGL	1110	College Composition I	3		

			Core Natural Science I	3		
			Core Natural Science Lab	1		
	ECON	1150	Principles Of Macroeconomics (Social science elective I)	3		
				16		
<b>Second Term</b>						
	MATH	2850	Elementary Multivariable Calculus	4	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-	
	ENGL	1130-1150	College Composition II	3		
	MATH	1890	Elementary Linear Algebra	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-	Math take math 2890 instead
	ECON	1200	Principles Of Microeconomics	3		
	BUAD	1020	Micro-Computer Applications In Business	3		
				16		
<b>Third Term</b>						
	MATH	4680	Introduction To Theory Of Probability	3	MATH 2850 Minimum Grade of C-	For actuarial P exam
	MATH	3190	Introduction To Mathematical Analysis	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-	
	BUAD	2040	Financial Accounting Information	3		
			Humanities Elective I	3		
			NSM Science Elective I	3		
				16		
<b>Fourth Term</b>						
	MATH	4690	Introduction To Mathematical Statistics	3	MATH 4680 Minimum Grade of C-	

	MATH	4620	Theory of Interest	3	MATH 4680 Minimum Grade of C-	For actuarial FM exam
			Courses needed to get to 124 hours	3		
			Humanities Elective II	3		
			NSM Science Elective II	3		
				15		
<b>Fifth Term</b>						
	MATH	3610	Statistical Methods I	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or 1930 Minimum Grade of C- or MATH 3190 Minimum Grade of C-	
	MATH	2860	Elementary Differential Equations	3	MATH 2850 Minimum Grade of C- or MATH 2950 Minimum Grade of C-	May take MATH 2860 or 3820 instead.
			NSM Science Elective III	4		
	BUAD	2050	Accounting For Business Decision-Making	3		
			Social Science Elective (II)	3		
				16		
<b>Sixth Term</b>						
	MATH	3620	Statistical Methods II	3	MATH 3610 Minimum Grade of C-	

Elective 3

	BUAD	3040	Principles Of Financial Management	3	BUAD 2040 Minimum Grade of C-	
			Multicultural Courses (US Diversity )	3		
			WAC College Requirement	3		
				15		
<b>Seventh Term</b>						
	MATH	4760	Actuarial Mathematics I	3	MATH 4680 Minimum Grade of C-	
			Courses needed to get to 124 hours	3		
	FINA	3600	Risk Management	3	BUAD 3040 Minimum Grade of C-	

			Multicultural Courses (Nonwestern )	3		
			Courses needed to get to 124 hours	3		
				15		
<b>Eighth Term</b>						

	MATH	4770	Actuarial Mathematics II	3	MATH 4760 Minimum Grade of C-	
	INFS	3150	Principles Of Structured Computer Programming And Problem Solving	3	BUAD 1020 Minimum Grade of C-	
			Courses needed to get to 124 hours	3		
			Courses needed to get to 124 hours	3		
				15		
			<b>Total Earned Credit Hours</b>	<b>124</b>		

### Additional Comments on the Related Courses in Bachelor of Science in Math

The 26 semester hours of related area course work should be chosen according to the interests of the student in view of his or her anticipated career in mathematics. These courses could be in Accounting, Astronomy, Biology, Chemistry, Economics, Environmental Science, Engineering, Finance, Operations Analysis, Philosophy, Physics, Pharmacy and Pharmaceutical Sciences, Medicine and Life Sciences.

Choices include courses numbered 2000 to 4990 for the following departments: ACCT, ASTR, BUAD, BIOE, CHEE, CHEM, CIVE, EBUS, EEES, FINA, GEOL, IBUS, IE, INBT, INBY, ISOM, ME, MIME, MGMT, MKTG, NASC, PHYS, PSLS, and TE; plus BIOL 2150 to 2180, 3000 to 4000; ECON 1150, 1200, 2000 to 4990; EECS 1100 to 4990.

### Degree Requirements, Bachelor of Arts:

To obtain a Bachelor of Arts degree in degree in mathematics, students must complete MATH 1840 (or 1860), 1890 (or 2890), 2850, and 2190 (or 3190) and follow one of the following concentrations for a total of at least 35 hours.

#### 1. Pure Mathematics

- The following are required: MATH 2860, 4330, 4820, and 4880.
- Two courses must be completed from MATH 4300, 4450, 4540, or 4830.
- The remaining course work may be chosen from courses at the 3000 or 4000 level approved by the Adviser.

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COURSE REQUIREMENTS	COMMENTS
<b>First Term</b>						
	NSM	1000	Orientation	2		
	MATH	1840	Calculus II For Mathematicians, Scientists And Educators	4	MATH 1340 Minimum Grade of C- or (MATH 1320 Minimum Grade of C- and MATH 1330 Minimum Grade of C-)	Actuarial Science students need to start in calculus II or may take Math 2850 in the summer. May substitute Math 1860
	ENGL	1110	College Composition I	3		
			Core Natural Science I	3		
			Core Natural Science Lab	1		
	ECON	1150	Principles Of Macroeconomics (Social science elective I)	3		
				16		
<b>Second Term</b>						
	MATH	2850	Elementary Multivariable Calculus	4	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-	
	ENGL	1130-1150	College Composition II	3		
	MATH	1890	Elementary Linear Algebra	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-	Math take math 2890 instead
	ECON	1200	Principles Of Microeconomics	3		
	BUAD	1020	Micro-Computer Applications In Business	3		
				16		
<b>Third Term</b>						
	MATH	4680	Introduction To Theory Of Probability	3	MATH 2850 Minium Grade of C-	For actuarial P exam



	MATH	3190	Introduction To Mathematical Analysis	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-	
	BUAD	2040	Financial Accounting Information	3		
			Humanities Elective I	3		
			NSM Science Elective I	3		
				16		
<b>Fourth Term</b>						
	MATH	4690	Introduction To Mathematical Statistics	3	MATH 4680 Minimum Grade of C-	
	MATH	4620	Theory of Interest	3	MATH 4680 Minimum Grade of C-	For actuarial FM exam
			Courses needed to get to 124 hours	3		
			Humanities Elective II	3		
			NSM Science Elective II	3		
				15		
<b>Fifth Term</b>						
	MATH	3610	Statistical Methods I	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or 1930 Minimum Grade of C- or MATH 3190 Minimum Grade of C-	
	MATH	2860	Elementary Differential Equations	3	MATH 2850 Minimum Grade of C- or MATH 2950 Minimum Grade of C-	May take MATH 2860 or 3820 instead.
			NSM Science Elective III	4		
	BUAD	2050	Accounting For Business Decision-Making	3		
			Social Science Elective (II)	3		
				16		
<b>Sixth Term</b>						
	MATH	3620	Statistical Methods II	3	MATH 3610 Minimum Grade of C-	

Elective 3

	BUAD	3040	Principles Of Financial Management	3	BUAD 2040 Minimum Grade of C-	
			Multicultural Courses (US Diversity )	3		
			WAC College Requirement	3		
				15		
<b>Seventh Term</b>						
	MATH	4760	Actuarial Mathematics I	3	MATH 4680 Minimum Grade of C-	
			Courses needed to get to 124 hours	3		
	FINA	3600	Risk Management	3	BUAD 3040 Minimum Grade of C-	
			Multicultural Courses (Nonwestern )	3		
			Courses needed to get to 124 hours	3		
				15		
<b>Eighth Term</b>						

	MATH	4770	Actuarial Mathematics II	3	MATH 4760 Minimum Grade of C-	
	INFS	3150	Principles Of Structured Computer Programming And Problem Solving	3	BUAD 1020 Minimum Grade of C-	
			Courses needed to get to 124 hours	3		
			Courses needed to get to 124 hours	3		
				15		
			<b>Total Earned Credit Hours</b>	<b>124</b>		

**2. Applied Mathematics**

- a. The following are required: MATH 3320 (or 4330), 2860, 4300 (or 4350), and 4820 (or 4880).
- b. One of the following two-semester sequences must be completed: MATH 4710 and 4720 or 4740 and 4750.
- c. The remaining course work may be chosen from courses at the 3000 or 4000 level approved by the Adviser.

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COURSE REQUIREMENTS
<b>First Term</b>					
	NSM	1000	Orientation	2	
	MATH	1830	Calculus I For Mathematicians, Scientists And Educators	4	MATH 1340 Minimum Grade of C- or (MATH 1320 Minimum Grade of C- and MATH 1330 Minimum Grade of C-)
	ENGL	1110	College Composition I	3	
			Core Natural Science I	3	
			Core Natural Science Lab	1	
			Social Science Elective I	3	
				16	
<b>Second Term</b>					
	MATH	1840	Calculus II For Mathematicians, Scientists And Educators	4	MATH 1830 Minimum Grade of C- or MATH 1850 Minimum Grade of C- or MATH 1920 Minimum Grade of C-
	ENGL	1130-1230	College Composition II	3	
			Core Natural Science (II )	3	
			Social Science Elective II	3	
			Multicultural Courses (US Diversity )	3	
				16	
<b>Third Term</b>					
	MATH	2850	Elementary Multivariable Calculus	4	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-
	MATH	3190	Introduction To Mathematical Analysis	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-
			Multicultural Courses (Non-Western )	3	
			Humanities Elective I	3	



			NSM Science Elective I	3		
				16		
<b>Fourth Term</b>						
	Math	3320	Into to Abstract Algebra		MATH 3190 Minimum Grade of C-	May take Math 4330 instead in fall semester
	MATH	2860	Elementary Differential Equations	3	MATH 2850 Minimum Grade of C- or MATH 2950 Minimum Grade of C-	
			NSM Science Elective II	3		
			Humanities Elective II	3		
			Related Field	3		
				15		
<b>Fifth Term</b>						
		MATH	MATH 1890	Elementary Linear Algebra		
	MATH	4710	Methods Of Numerical Analysis I	3	MATH 2860 Minimum Grade of C- or MATH 3820 Minimum Grade of C-	
			Foreign Language I	4		
			History Elective	3		
			Related Elective	3		
				16		
<b>Sixth Term</b>						
	MATH	4720	Methods Of Numerical Analysis II	3	MATH 4720 Minimum Grade of C-	
	MATH	4880	Complex Variables	3	MATH 2860 Minimum Grade of C- or MATH 3820 Minimum Grade of C-	
			Foreign Language II	4		
			Related Elective	3		
			WAC College Requirement	3		
				16		
<b>Seventh Term</b>						
	MATH	4820	Introduction To Real Analysis I	3	MATH 3190 Minimum Grade of C-	

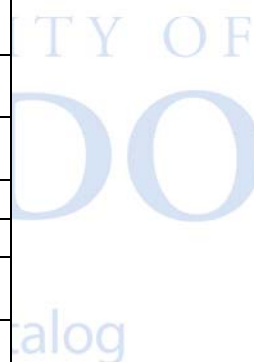
			Advanced Math Elective	3	
			Fine Art Elective	3	
			Related Elective	3	
			Social Science Elective III	3	
				15	
<b>Eighth Term</b>					
	MATH	4350	Applied Linear Algebra	3	MATH 1890 Minimum Grade of C- or MATH 2890 Minimum Grade of C-
			Advanced Math Elective	3	
			Related Elective	3	
			Related Elective	3	
			English Literature Elective	2	
				14	
			<b>Total Earned Credit Hours</b>	<b>124</b>	

### 3. Statistics

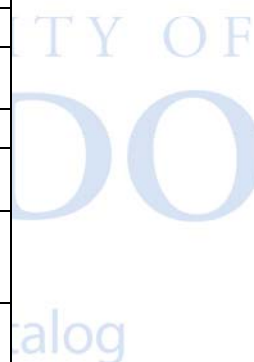
- a. The following courses are required: MATH 3610, 3620, 4350, 4600, 4610, 4680, and 4690.

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COURSE REQUIREMENTS
<b>First Term</b>					
	NSM	1000	Orientation	2	
	MATH	1830	Calculus I For Mathematicians, Scientists And Educators	4	MATH 1340 Minimum Grade of C- or (MATH 1320 Minimum Grade of C- and MATH 1330 Minimum Grade of C-)
	ENGL	1110	College Composition I	3	
			Core Natural Science I	3	
			Core Natural Science Lab	1	
			Social Science Elective I	3	
				15	
<b>Second Term</b>					
	MATH	1840	Calculus II For Mathematicians, Scientists And Educators	4	MATH 1830 Minimum Grade of C- or MATH 1850 Minimum Grade of C- or MATH 1920 Minimum Grade of C-

	ENGL	1130-1230	College Composition II	3	
			Core Natural Science (II)	3	
			Social Science Elective II	3	
	MATH	1890	Multicultural Courses (US Diversity)	3	
				16	
<b>Third Term</b>					
	MATH	2850	Elementary Multivariable Calculus	4	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-
	MATH	3190	Introduction To Mathematical Analysis	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-
			Multicultural Courses (Non-Western)	3	
			Humanities Elective I	3	
			NSM Science Elective I	3	
				16	
<b>Fourth Term</b>					
	MATH	1890	Elementary Linear Algebra	3	MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or MATH 1930 Minimum Grade of C-
	MATH	2860	Elementary Differential Equations	3	MATH 2850 Minimum Grade of C- or MATH 2950 Minimum Grade of C-
			NSM Science Elective II	3	
			Humanities Elective II	3	
			Related Field	3	
				15	
<b>Fifth Term</b>					



					MATH 1840 Minimum Grade of C- or MATH 1860 Minimum Grade of C- or 1930 Minimum Grade of C- or MATH 3190 Minimum Grade of C-
	MATH	3610	Statistical Methods I	3	
	MATH	4680	Introduction To Theory Of Probability	3	MATH 2850 Minium Grade of C-
			Foreign Language I	4	
			History Elective	3	
			Related Elective	3	
				16	
<b>Sixth Term</b>					
	MATH	3620	Statistical Methods II	3	MATH 3610 Minimum Grade of C-
	MATH	4690	Introduction To Mathematical Statistics	3	MATH 4680 Minimum Grade of C-
			Foreign Language II	4	
			Related Elective	3	
			WAC College Requirement	3	
				16	
<b>Seventh Term</b>					
	MATH	4600	Applications of Statistics I	3	MATH 4680 Minimum Grade of C-
			Advanced Math Elective	3	
			Related Elective	3	
			Fine Art Elective	3	
			Social Science Elective III	3	
				15	
<b>Eighth Term</b>					
	MATH	4350	Applied Linear Algebra	3	MATH 1890 Minimum Grade of C- or MATH 2890 Minimum Grade of C-
	MATH	4610	Applications of Statistics II	3	
			Related Elective	3	
			English Literature Elective	3	
			General Elective	2	
				14	



			<b>Total Earned Credit Hours</b>	<b>124</b>	
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### **Additional Comments on the Related Courses in Bachelor of Arts in Math**

The 24 semester hours of related area course work (at 2000 to 4000 levels) should be chosen according to the interests of the student in view of his or her anticipated career in mathematics. The B.A. degree is awarded to those students who choose a related area in the humanities or social sciences, such as economics, foreign language, philosophy and psychology, or education.

Choices include courses numbered 2000 to 4990 for the following departments: AMST, ARTH, COMM, DST, FILM, GEPL, GLST, HIST, HON, LST, PHIL, PSC, PSY, REL, SOC, THR, WGST; or courses numbered 3000 to 4990 for the following departments: CLC, ENGL, FREN, GERM, HUM, JAPN, LAT, LING, SPAN; plus AFST 2100 to 4990, ANTH 2100 to 4990, ART 1080 to 4990, ECON 1150, 1200, 2000 to 4000, FLAN 3440, MUS 2260, 2270, 2280, 2410, 2420, 2610, 2620, 3000 to 4000, excluding MUS 3010, 3020, 3030, 3040, 3050, 3090, 3130, 3140, 3150, 3160, 3170, 3180, 3190, 3800, 4800.

### **Minor in Mathematics**

To obtain a minor in mathematics, a minimum of 22 hours in mathematics must be completed. The 22 hours must include MATH 1840 (or 1860), 1890 (or 2890), 2850 and one of 3610, 2860 or 4680. The remaining hours must be courses that are acceptable toward a major in mathematics and must be approved by an Adviser in the department of mathematics.

### **Honors in Mathematics**

- A. Admission:** Students are normally admitted to departmental honors after completing the Honors sections of MATH 1850, 1860, 2850, and 2860. Students may also be admitted to the program at the discretion of the Math Majors Committee and should consult the departmental Undergraduate Adviser.
- B. Requirements:** Graduation with honors in mathematics depends upon doing a substantial amount of work in mathematics beyond the requirements of the bachelor's degree. To graduate with departmental honors in mathematics a student must ordinarily maintain a GPA in mathematics greater than 3.5 and write an expository paper on a topic in mathematics that demonstrates knowledge of the subject matter significantly beyond the expectations of the student's course work. The research and writing of the paper is conducted under the supervision of a faculty member with an interest in the subject, and as a part of fulfilling this requirement the student must enroll in either the junior or senior reading class, MATH 3920 or MATH 4920, that counts as an elective in the major. The actual details of the student's program are determined by consulting with the Department's honors adviser and the student's topic supervisor.

### **Department of Physics and Astronomy**

Sanjay V. Khare, Chair

Jacques G. Amar, Associate Chair

Scott A. Lee, Undergraduate and Honors Adviser, both Physics and Astronomy

Song Cheng, Graduate Program Director

Sanjay V. Khare, Coordinator, Minor in Renewable Energy



## Degrees Offered

The department of physics and astronomy offers courses of study leading to the Bachelor of Science degree in physics, the Bachelor of Arts in physics and the Bachelor of Arts in astronomy (see astronomy section earlier in this catalog).

## Advanced Placement

Students with a score of 3, 4 or 5 on the Physics B test will receive credit for PHYS 2070 and 2080. Students with a score of 3, 4 or 5 on the Physics C Mechanics test will receive credit for PHYS 2130; students with a score of 3, 4 or 5 on the Physics C Electricity and Magnetism test will receive credit for PHYS 2140.

## Requirements for the Bachelor of Science in Physics

The B.S. in physics consists of a core program that all students must complete and a choice of one concentration with additional requirements as listed below. The core program contains 34 hours of physics courses and 29 hours of related-area courses; the concentrations contain an additional 6-20 hours of physics, astronomy and related courses.

## Concentrations

The student must choose one of the following concentrations:

BS in Physics with a Physics Concentration:

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS
<b>First Term</b>				
	NSM	1000	ORIENTATION	2
	ENGL	1110	COMP I	3
	MATH	1830or1850or1920	CALCULUS I	4
	PHYS	1910	FRONTIERS OF PHYSICS	3
	PHYS	2130	PHYSICS I	5
				17
<b>Second Term</b>				
	ENGL	1130-1150	COMP II	3
	MATH	1890or2890	LINEAR ALGEBRA	3
	MATH	1840or1860or1930	CALCULUS II	4
	PHYS	2140	PHYSICS II	5
				15
<b>Third Term</b>				
	PHYS	3310	MODERN PHYSICS I - WAC	3
	CHEM	1230	GEN CHEMISTRY I	4
	CHEM	1280	GEN CHEMISTRY I LAB	1
	MATH	3610	STATISTICAL METHODS I	3
	MATH	2850or2950or2880	MULTIVARIABLE CALCULUS	4
				15
<b>Fourth Term</b>				
	PHYS	3180	INTERMEDIATE LAB	3
	MATH	3860or2860or3820or3880	DIFFERENTIAL EQUATIONS	3
	PHYS	3410	THERMAL PHYSICS	3
			CORE SOCIAL SCIENCE	3

	EECS	1500	INTRO TO PROGRAMMING	3
				15
<b>Fifth Term</b>				
	PHYS	4230	ELECTRICITY AND MAGNETISM I	3
	PHYS	4210	THEORETICAL MECHANICS	3
			CORE HUMANITIES	3
			NON-PHYSICS WAC COURSE	3
			NON-WESTERN	3
				15
<b>Sixth Term</b>				
	PHYS	4240	ELECTRICITY AND MAGNETISM II	3
	PHYS	4310	QUANTUM MECHANICS	3
			MAJOR LEVEL BIOL, EEES, eg BIOL 2150, 2170, EEES 2010, 2100, or 2150*	3-4
			US DIVERSITY	3
			CORE SOCIAL SCIENCE	3
				15-16
<b>Seventh Term</b>				
	PHYS	4580or4780	ADVANCED LABORATORY (eg 4780)	3
	PHYS	4910	RESEARCH IN PHYSICS	2
	PHYS	4950	PROFESSIONAL DEVELOPMENT	1
			CORE HUMANITIES	3
			COURSES NEEDED TO REACH 120 HOURS	6
				15
<b>Eighth Term</b>				
	PHYS	4910	RESEARCH IN PHYSICS	2
	PHYS	4920	PHYSICS CAPSTONE PROJECT	1
			COURSES NEEDED TO REACH 120 HOURS	9- 10
				12-13
			<b>Total Earned Credit Hours</b>	<b>120</b>

### BS in Physics with a concentration in Biomedical Physics

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS
<b>First Term</b>				
	NSM	1000	ORIENTATION	2

	ENGL	1110	COMP I	3
	MATH	1830or1850or1920	CALCULUS I	4
	PHYS	1910	FRONTIERS OF PHYSICS	3
	PHYS	2130	PHYSICS I	5
				17
<b>Second Term</b>				
	ENGL	1130-1150	COMP II	3
	MATH	1890or2890	LINEAR ALGEBRA	3
	MATH	1840or1860or1930	CALCULUS II	4
	PHYS	2140	PHYSICS II	5
				15
<b>Third Term</b>				
	PHYS	3310	MODERN PHYSICS I - WAC	3
	CHEM	1230	GEN CHEMISTRY I	4
	CHEM	1280	GEN CHEMISTRY I LAB	1
	MATH	3610	STATISTICAL METHODS I	3
	MATH	2850or2950or2880	MULTIVARIABLE CALCULUS	4
				15
<b>Fourth Term</b>				
	PHYS	3180	INTERMEDIATE LAB	3
	MATH	3860or2860or3820or3880	DIFFERENTIAL EQUATIONS	3
	PHYS	3410	THERMAL PHYSICS	3
			CORE SOCIAL SCIENCE	3
	EECS	1500	INTRO TO PROGRAMMING	3
				15
<b>Fifth Term</b>				
	PHYS	4230	ELECTRICITY AND MAGNETISM I	3
	PHYS	4210	THEORETICAL MECHANICS	3
			CORE HUMANITIES	3
			NON-PHYSICS WAC COURSE	3
			NON-WESTERN	3
				15
<b>Sixth Term</b>				
	PHYS	4240	ELECTRICITY AND MAGNETISM II	3
	PHYS	4310	QUANTUM MECHANICS	3
	BIOL	2150+2160	FUNDAMENTALS OF LIFE SCIENCE	5
			US DIVERSITY	3
				14
<b>Seventh Term</b>				
	PHYS	4430	BIOMEDICAL PHYSICS I	3

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	PHYS	4580or4780	ADVANCED LABORATORY (eg 4780)	3
	PHYS	4910	RESEARCH IN PHYSICS	2
	PHYS	4950	PROFESSIONAL DEVELOPMENT	1
	KINE	2510+2520	HUMAN ANATOMY	4
			CORE HUMANITIES	3
				16
<b>Eighth Term</b>				
	PHYS	4440	BIOMEDICAL PHYSICS II	3
	PHYS	4910	RESEARCH IN PHYSICS	2
	PHYS	4920	PHYSICS CAPSTONE PROJECT	1
	KINE	2530+2540	HUMAN PHYSIOLOGY	4
			CORE SOCIAL SCIENCE	3
			COURSES NEEDED TO REACH 120 HOURS	
				13
			<b>Total Earned Credit Hours</b>	<b>120</b>

BS in Physics with a concentration in Applied Physics

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS
<b>First Term</b>				
	NSM	1000	ORIENTATION	2
	ENGL	1110	COMP I	3
	MATH	1830or1850or1920	CALCULUS I	4
	PHYS	1910	FRONTIERS OF PHYSICS	3
	PHYS	2130	PHYSICS I	5
				17
<b>Second Term</b>				
	ENGL	1130-1150	COMP II	3
	MATH	1890or2890	LINEAR ALGEBRA	3
	MATH	1840or1860or1930	CALCULUS II	4
	PHYS	2140	PHYSICS II	5
				15
<b>Third Term</b>				
	PHYS	3310	MODERN PHYSICS I - WAC	3
	CHEM	1230	GEN CHEMISTRY I	4
	CHEM	1280	GEN CHEMISTRY I LAB	1
	MATH	3610	STATISTICAL METHODS I	3
	MATH	2850or2950or2880	MULTIVARIABLE CALCULUS	4
				15
<b>Fourth Term</b>				
	PHYS	3180	INTERMEDIATE LAB	3

	MATH	3860or2860or3820or3880	DIFFERENTIAL EQUATIONS	3
	PHYS	3410	THERMAL PHYSICS	3
			CORE SOCIAL SCIENCE	3
	EECS	1500	INTRO TO PROGRAMMING	3
				15
<b>Fifth Term</b>				
	PHYS	4230	ELECTRICITY AND MAGNETISM I	3
	PHYS	4210	THEORETICAL MECHANICS	3
			CORE HUMANITIES	3
			NON-PHYSICS WAC COURSE	3
			NON-WESTERN	3
				15
<b>Sixth Term</b>				
	PHYS	4240	ELECTRICITY AND MAGNETISM II	3
	PHYS	4310	QUANTUM MECHANICS	3
			MAJOR LEVEL BIOL, EEES, eg BIOL 2150, 2170, EEES 2010, 2100, or 2150*	3-4
			US DIVERSITY	3
			CORE SOCIAL SCIENCE	3
				15-16
<b>Seventh Term</b>				
	PHYS	3610	OPTICS AND LASERS	3
	PHYS	4510	CONDENSED MATTER	3
	PHYS	4910	RESEARCH IN PHYSICS	2
	PHYS	4950	PROFESSIONAL DEVELOPMENT	1
			CORE HUMANITIES	3
			COURSES NEEDED TO REACH 120 HOURS	3
				15
<b>Eighth Term</b>				
			3000/4000 PHYSICS OR ENG	3
	PHYS	4580 or 4780	ADVANCED LAB (eg 4580)	3
	PHYS	4910	RESEARCH IN PHYSICS	2
	PHYS	4920	PHYSICS CAPSTONE PROJECT	1
			COURSES NEEDED TO REACH 120 HOURS	4
				13
			<b>Total Earned Credit Hours</b>	<b>120</b>

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BS in Physics with a concentration in Astrophysics

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS
<b>First Term</b>				
	NSM	1000	ORIENTATION	2
	MATH	1830or1850or1920	CALCULUS I	4
	ASTR	2010	SOLAR SYTEM ASTRONOMY	3
	PHYS	1910	FRONTIERS OF PHYSICS	3
	PHYS	2130	PHYSICS I	5
				17
<b>Second Term</b>				
	ENGL	1110	COMP I	3
	MATH	1840or1860or1930	CALCULUS II	4
	ASTR	2020	ASTR 2020 STARS, GALAXIES, & THE UNIVERSE	3
	PHYS	2140	PHYSICS II	5
				15
<b>Third Term</b>				
	PHYS	3310	MODERN PHYSICS I - WAC	3
	CHEM	1230	GEN CHEMISTRY I	4
	CHEM	1280	GEN CHEMISTRY I LAB	1
	MATH	3610	STATISTICAL METHODS I	3
	MATH	2850or2950or2880	MULTIVARIABLE CALCULUS	4
				15
<b>Fourth Term</b>				
	ENGL	1130-1150	COMP II	3
	ASTR	3880	Foundations of Astronomy	4
	MATH	3860or2860or3820or3880	DIFFERENTIAL EQUATIONS	3
	MATH	1890or2890	LINEAR ALGEBRA	3
	EECS	1500	INTRO TO PROGRAMMING	3
				16
<b>Fifth Term</b>				
	PHYS	4230	ELECTRICITY AND MAGNETISM I	3
	PHYS	4210	THEORETICAL MECHANICS	3
			MAJOR LEVEL BIOL, EEES, eg BIOL 2150, 2170, EEES 2010, 2100, or 2150*	3-4
			NON-PHYSICS WAC COURSE	3
			NON-WESTERN	3
				15- 16
<b>Sixth Term</b>				
	PHYS	4240	ELECTRICITY AND MAGNETISM II	3
	PHYS	4310	QUANTUM MECHANICS	3
	PHYS	3410	THERMAL PHYSICS	3
			US DIVERSITY	3
			CORE SOCIAL SCIENCE	3

				15
<b>Seventh Term</b>				
	ASTR	4810	ASTROPHYSICS I	3
	ASTR	4880	ASTROPHYSICAL MEASUREMENTS	3
	PHYS	4910	RESEARCH IN PHYSICS	2
	PHYS	4950	PROFESSIONAL DEVELOPMENT	1
			CORE HUMANITIES	3
			COURSES NEEDED TO REACH 120 HOURS	3
				15
<b>Eighth Term</b>				
	ASTR	4820	ASTROPHYSICS II	3
	PHYS	4910	RESEARCH IN PHYSICS	2
	PHYS	4920	PHYSICS CAPSTONE PROJECT	1
			CORE HUMANITIES	3
			CORE SOCIAL SCIENCE	3
			COURSES NEEDED TO REACH 120 HOURS	
				12
			<b>Total Earned Credit Hours</b>	<b>120</b>

### Comments on BS in Physics Curriculum (including concentrations):

**Recommended introductory course:** PHYS 1910 is strongly recommended.

**Core physics courses:** PHYS 2130, 2140, 3310, 3410, 4210, 4230, 4240, 4310, 4920, 4950 and 4 hours of PHYS 4910 are required. With department approval, a student may substitute PHYS 2070, 2080 and 2100 for PHYS 2130 and 2140.

**Related courses:** CHEM 1230 and 1280, EECS 1500, one of MATH 1830, 1850 or 1920, one of MATH 1840, 1860, or 1930, one of MATH 1890, or 2890, one of MATH 2850, 2880, or 2950, one of MATH 2860, 3820, or 3880, MATH 3610 and one additional course (3-4) hours chosen from major-level courses in biology, chemistry, or environmental sciences are required.

**Physics:** PHYS 3180, and either 4580 or 4780.

**Astrophysics:** ASTR 2010, 2020, 3880, 4810, 4820, and 4880.

**Applied Physics:** PHYS 3180, 3610, 4510, and either 4580 or 4780, plus three hours of appropriate courses from physics or engineering, chosen with the Adviser's approval.

**Biomedical Physics:** PHYS 3180, 4430, 4440, and either 4580 or 4780; and related courses BIOL 2150 and 2160 (which satisfies the related major-level course requirement above), plus KINE 2510, 2520, 2530 and 2540 (or alternate sequence KINE 2460, 2470, 2560, and 2570)

In addition to the above requirements, students should consider the following recommended elective courses MATH 4740 and 4750.

### Requirements for the Bachelor of Arts in Physics

The B.A. in physics consists of 34 hours in the department of physics and astronomy, 15 hours of mathematics, and at least 9 additional hours in the natural sciences and mathematics, chosen with the Adviser's approval. This program is intended to provide the flexibility required by students who wish to pursue interdisciplinary studies, or prepare for careers in teaching or other professions requiring a fundamental understanding of the physical sciences.

Term	SUBJECT	NUMBER	COURSE TITLE	CR HRS	COURSE REQUIREMENTS	PROG. ALTERNATIVES
<b>First Term</b>						
	NSM	1000	Orientation	2	None	
	PHYS	1910	Frontiers of Physics	3	None	Or electives to reach 124 hours
	ENGL	1110	English Composition I	3	None	
			Foreign Lang I	4		(or PHYS 2130)
	MATH	1830or1850or1920	CALCULUS I	4	MATH 1340 if necessary	
<b>Total</b>				<b>14</b>		
<b>Second Term</b>						
	PHYS	2130	Physics for Sci Majors I	5	None	or PHYS 2070 (or PHYS 2140)
	MATH	1840or1860or1930	CALCULUS II	4	MATH 1850	or MATH 1840, 1930
	ENGL	1130	English Composition II	3	ENGL 1110	or ENGL 1140, 1150, 2950, 2960
			Foreign Lang II	4	Foreign Lang I	(or Foreign Lang I)
<b>Total</b>				<b>16</b>		
<b>Third Term</b>						
	PHYS	2140	Physics for Sci Majors II	5	PHYS 2130	or PHYS 2080 and 2100 (or Foreign Lang II)
			Core Humanities I	3		
	MATH	2850	Calculus III	4		or MATH 2950
	MATH	3610	Statistical Methods I	3	MATH 1840or1860or1930	
<b>Total</b>				<b>15</b>		If 16, take one less course in future semester
<b>Fourth Term</b>						
	PHYS	3180	Intermediate Laboratory	3	PHYS 2140 or 2100	
			Choose one from BIOL 2150 to 4xxx, CHEM 1230 to 4xxx, EEES 2010 to 4xxx	3-4		
			Core Humanities II	3		
			Core Social Science I	3		
			Fine Arts	3		



<b>Total</b>				<b>15-16</b>	
<b>SPECIAL CONSIDERATIONS</b>					
(e.g. Students must be accepted into upper division; Acceptance requires the completion of 60 semester credit hours of approved courses and a minimum grade point average of 2.25)					
<b>Fifth Term</b>					
	PHYS	3310	MODERN PHYSICS - WAC	3	MATH 1860, PHYS 2140 or 2100
	Electives		3000-4000 level Phys	3	
			Core Social Science II	3	
			History	3	
	Elective		Elective(s)-to reach 120 hours	3	
<b>Total</b>				<b>15</b>	
<b>Sixth Term</b>					
	Electives		3000-4000 level Phys	3	
			Choose one from BIOL 2150 to 4xxx, CHEM 1230 to 4xxx, EEES 2010 to 4xxx	3-4	
			Soc Sci	3	
	Elective		Elective(s)-to reach 120 hours	4-5	
<b>Total</b>				<b>14</b>	
<b>Seventh Term</b>					
	PHYS	4950	PROFESSIONAL DEVELOPMENT	1	
	Electives		3000-4000 level Phys	3	
	Eng Lit		College Requirement	3	
			US Diversity	3	
	Elective		Elective(s) > 3000-level -to reach 120 hours	5	
<b>Total</b>				<b>15</b>	
<b>Eighth Term</b>					
	PHYS	4920	PHYSICS CAPSTONE PROJECT	1	
	Electives		3000-4000 level Phys	6	

			Non-Western	3	
			WAC	3	
<b>Total</b>				<b>13</b>	
			<b>Total Earned Credit Hours</b>	<b>120</b>	32 hrs @>3000

**Comments on BS in Physics Curriculum:**

**Recommended introductory course:** PHYS 1910 is strongly recommended.

**Basic physics sequence:** Either the sequence PHYS 2130 and 2140 (10 hours) or the sequence PHYS 2070, 2080 and 2100 (12 hours) is required.

**Advanced physics courses:** PHYS 3180, 3310, 4920 and 4950 are required.

**Elective courses in the major:** At least 16 hours of additional physics or astronomy courses numbered above 3000 are required.

**Required mathematics courses:** One of MATH 1830, 1850 or 1920, one of MATH 1840, 1860 or 1930, one of MATH 2850, 2880 or 2950 and MATH 3610 are required.

**Other courses in related areas:** At least 9 hours of other natural science courses must be taken, of which at least two courses must be major-level courses chosen from biology, chemistry, or environmental sciences, with the selection approved by the student's Adviser. Possibilities include BIOL 2150, 2160, 2170 and 2180; CHEM 1230, 1240, 1280 and 1290; and EEES, 2010 and 2100.

**Requirements for the Bachelor of Arts in Astronomy**

Please refer to the astronomy section earlier in this catalog.

**Minor in Physics or Astrophysics**

Students seeking a minor in physics or astrophysics must complete at least 22 hours (23 hours for astrophysics) of course work in physics as follows:

**Required for both minors:**

PHYS 2130 and 2140 (or 2070, 2080 and 2100), and 3310.

**Required for the physics minor:**

PHYS 3180 and two physics courses numbered above 3400.

**Required for the astrophysics minor:** ASTR 2010, 2020 and 3880.

Students must maintain a minimum GPA of 2.0 for all course work in the minor. Candidates for the minor must have their course work verified and approved by a departmental Adviser or Chair prior to making formal application for graduation.

**Minor in Renewable Energy** (This minor is interdisciplinary)

The Minor in Renewable Energy (MRE) has been established as an interdisciplinary minor program. It is designed for students in the STEM areas majoring in the following departments: Physics and Astronomy, Chemistry, Environmental Sciences, Biology, Mathematics, MIME, Chemical and Environmental Engineering, Electrical Engineering and Computer Science, Civil Engineering and Bioengineering. Students with other majors can enroll in the MRE provided they complete the prerequisite courses. The goal of the minor is to expose students to quantitative analyses of the use of energy in human societies, its consequences and environmental impacts. A primary focus will be on the advantages and complexities of introducing renewable energy resources. Students will be required to take at least one course in the social, political, and economic ramifications of the use of energy in general and renewable energy in particular. An internship is required to enhance the practical training of students

**Course requirements are as follow:** Students must complete at least 21 hours of coursework selected as follows: Four required courses

- PHYS 3400 Physical Principles of Energy Sources for Humans, 3 credit hours
- EEES 2200/GEPL 2200 Climate Change, 3 credit hours
- CHEM 3810 Chemistry of Sustainable Energy Resources, 3 credit hours
- PHYS 4940 Internship in Renewable Energy, 3 credit hours

Select one from

- PSC 4340 Environmental Policy, 3 credit hours
- ECON 3240 Environmental Economics, 3 credit hours

Select two of the following

- PHYS 4400 Varieties of Solar Energy, 3 credit hours
- MIME 4980 Renewable Energy, 3 credit hours
- CHEE/BIOE 4980 Biofuels, 3 credit hours
- CHEE 4980 Fuel Cells and the Hydrogen Economy, 3 credit hours

**Prerequisites:** PHYS 2080 General Physics II or higher, CHEM 1240 General Chemistry II, both courses under CHEE 4980 require MATH 1850 Single Variable Calculus I.

### **Honors in Physics and Astronomy**

Qualified juniors and seniors may be invited to work for the citation “honors in physics and astronomy.”

A. Admission: The Honors Program in the department of physics and astronomy is open to physics majors and may be taken concurrently with College Honors. Admission to the program is based upon the student's academic achievement (at least a 3.0 GPA overall; at least a 3.3 GPA in the major), recommendations of previous instructors and an interview with the departmental honors officer. A petition for entrance into the program normally should be made before the end of the sophomore year.

B. Requirements: In order to remain in the program and graduate with departmental honors, the students must maintain at least a 3.0 cumulative GPA and at least a 3.3 GPA in the major. In addition to the normal requirements for a physics undergraduate major, the student must successfully complete six hours of physics with honors in courses numbered above 3320\*, six hours of math chosen from MATH 2860 and other math courses above the 3000 level. The written and oral reports required for PHYS 4920 will strongly influence the granting of the honors citation.

*\*ASTR 4810, 4820 may count toward this requirement.*

## **FACULTY**

### **Department of Biological Sciences**

**Brian P. Ashburner**, 2001, Vice Provost and Associate professor  
B.A., St. Anselm College; Ph.D. Loyola University of Chicago

**Tomer Avidor-Reiss**, 2012, Associate professor  
B.S. Hebrew University; Ph.D. Weizmann Institute of Science

**Bruce Bamber**, 2006, Associate professor and Chair  
B.Sc., University of Calgary; Ph.D., University of Washington

**Deborah Chadee**, 2005, Professor and Associate Chair  
B.S., University of Manitoba; Ph.D., University of Manitoba

**Qian Chen**, 2016 Assistant professor

B.S., Peking University; M.S. Institute of Genetics, Chinese Academy of Science; Ph.D., University of Texas, Austin

**Heather Conti**, 2015, Assistant professor

B.S., State University of New York College at Fredonia; Ph.D., University of Buffalo

**Scott Crawley**, 2016, Assistant Professor  
 B.S., St Francis Xavier University, M.S., Ph.D., Queen's University

**Maria Diakonova**, 2006, Associate professor  
 Sc.B., M.S., Leningrad State University; Ph.D., Russian Academy of Sciences

**Fan Dong**, 2002, Professor  
 M.D., Suzhou Medical College; Ph.D., Erasmus University

**Jianyang Du**, 2016, Assistant Professor  
 B.S., Sichuan University, Ph.D., Sun Yassin University

**Rafael Garcia-Mata**, 2012, Assistant professor  
 B.S. Universidad Nacional de Mar del Plata; PhD, University of Alabama at Birmingham

**John Gray**, 1998, Associate professor  
 B.Sc. (Hons), University College Cork; Ph.D., Purdue University

**Malathi Krishnamurthy**, 2010, Associate professor  
 B.S., M.S., University of Delhi; Ph.D., Jawaharlal Nehru University

**Scott M. Leisner**, 1993, Professor  
 B.S., University of Wisconsin; Ph.D., Purdue University

**Guofa Liu**, 2008, Associate professor  
 M.B., Suzhou Medical College; M.S., Beijing Medical University; Ph.D., Shanghai Second Medical University

**Song-Tao Liu**, 2007, Professor  
 B.S., Wuhan University; Ph.D., Shanghai Institute of Biochemistry

**John Plenefisch**, 1996, Associate Dean and Associate professor  
 B.S., University of Connecticut; Ph.D., Massachusetts Institute of Technology

**Anthony Quinn**, 2001, Assistant Dean and Associate professor  
 B.A., Mid-American Nazarene College, M.S., University of Missouri - Saint Louis, Ph.D., University of Oklahoma Health Science Center

**Lirim Shemshedini**, 1993, Professor  
 B.S., University of Michigan; Ph.D., University of Vermont

**William Taylor**, 2003, Professor  
 B.S., University of Winnipeg; Ph.D., University of Manitoba

**Deborah Vestal**, 2002, Associate professor  
 B.S., Bowling Green State University; Ph.D., Syracuse University

#### **Emeritus Faculty**

**William L. Bischoff Jr.**, 1972, professor emeritus, 2007  
 B.A., M.A., Miami University; Ph.D., University of North Carolina

**Ernest Dubrul**, 1974, professor emeritus, 2010  
 H.A.B., Xavier University; Ph.D., Washington University

**Louis Glatzer**, 1973, professor emeritus, 1999  
 A.B., Dartmouth College; M.S., North Carolina State University; Ph.D., The University of Texas - Austin

**Lloyd A. Jones**, 1972, professor emeritus, 1999  
 B.S., M.S., The Ohio State University; Ph.D., Purdue University

**Won H. Jung**, 1964, professor emeritus, 1993  
 B.S., Seoul National University; M.S., Ph.D., Michigan State University

**Richard W. Komuniecki**, 1980, Distinguished University Professor emeritus  
 A.B., Holy Cross College; M.S., Ph.D., University of Massachusetts

**Patricia R. Komuniecki**, 1985, dean and professor emerita, B.A., Newton College (Boston College); M.A., Mount Holyoke College; Ph.D., University of Massachusetts

**Harold H. Lee**, 1967, professor emeritus, 1999  
 A.B., Oklahoma Baptist University; M.S., Ph.D., University of Tennessee

**Clifford J. Smith**, 1965, professor emeritus, 1993  
 B.S., Cornell University; Ph.D., University of Maryland

#### **Lecturer**

**Sally Harmych**, 2006, Senior Lecturer  
 B.S., Ph.D. University of Toledo

**Brenda Leady**, 1993, Associate Lecturer

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**Robert Steven**, 2006, Senior Lecturer

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### **Department of Chemistry and Biochemistry**

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**John J. Bellizzi, III**, 2008, Associate Professor

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**Terry P. Bigioni**, 2006, Professor

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**Eric W. Findsen**, 1988, Associate Professor

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**Dean M. Giolando**, 1988, Professor

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**Xiche Hu**, 1998, Associate Professor

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**Dragan Isailovic**, 2008, Associate Professor

Diploma – Physical Chemistry, University of Belgrade, Serbia; Ph.D., Iowa State University

**Ajith Karunaratne**, 2014, Assistant Professor

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**Jon R. Kirchhoff**, 1989, Distinguished University Professor and Chair

B.S., State University of New York - Cortland; Ph.D., Purdue University

**Wei Li**, 2015, Assistant Professor

B.S., University of North Carolina; Ph.D., University of Michigan

**Cora Lind-Kovacs**, 2003, Professor and Associate Chair

Prediploma, Bergische Universität Wuppertal; M.S., Ph.D., Georgia Institute of Technology

**Mark R. Mason**, 1998, Professor

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**Timothy C. Mueser**, 2000, Associate Professor

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**Donald R. Ronning**, 2005, Professor

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**Joseph A. R. Schmidt**, 2004, Professor

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**Steven J. Sucheck**, 2005, Professor

B.S., University of Toledo; Ph.D., University of Virginia

**Ronald E. Viola**, 2000, Distinguished University Professor

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**Michael C. Young**, 2016, Assistant Professor

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**Jianglong Zhu**, 2010, Professor

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### **Lecturers**

**Claire Cohen-Fray**, 2007, Senior Lecturer

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**Kristi L. Mock**, 2014, Associate Lecturer

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B.S., Central State College; Ph.D., Oklahoma State University

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**Max O. Funk**, 1978, Distinguished University Professor Emeritus, 2013  
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**James E. Gano**, 1967, Professor Emeritus, 2000  
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**Robert J. Niedzielski**, 1965, Professor Emeritus, 1999  
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**Timothy G. Fisher**, 2003, Professor and chair  
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 B.S., M.S., Ph.D., West Virginia University  
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**James A. Harrell**, 1979, Professor emeritus, 2009  
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 B.S., The University of Akron; M.S., Purdue University  
**Alessandro Arsie**, 2009, Associate professor and associate chair  
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**Tian Chen**, 2015, Assistant professor  
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**Alimjon Eshmatov**, 2016, Assistant professor  
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**Trieu Le**, 2015, Assistant professor  
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**Rong Liu**, 2009 Associate professor  
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**Geoffrey K. Martin**, 1989, Associate professor  
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 B.S., Harvey Mudd College; M.S., California Polytechnic University - Pomona; Ph.D., University of Wisconsin  
**Biao Ou**, 1993, Professor  
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**Sonmez Sahutoglu**, 2009, Associate professor  
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**Chunhua Shan**, 2016, Assistant professor  
 B.S., M.S. Nanjing Normal University (China); Ph.D., University of York (Canada)

**Qin Shao**, 2002, professor

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B.S., M.A., Long Beach State University; Ph.D., University of California at Los Angeles

**Gerard Thompson**, 1988, Professor

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**Mary F. Coughlin**, 1969, Professor emeritus, 1989

B.A., Marygrove College; M.S., St. Louis University; Ph.D., University of Michigan

**Budmon R. Davis**, 1962, Professor emeritus, 1989

B.S., Geneva College; M.A., Ph.D., University of Pittsburgh

**Paul R. Hewitt**, 1990, Associate professor emeritus, 2016

B.S., Michigan Technological University; Ph.D., Michigan State University

**George J. Kertz**, 1966, Professor emeritus, 1999

A.B., Cardinal Glennon College; M.A., Ph.D., St. Louis University

**Walter Lange**, 1967, Professor emeritus, 1989

M.Ed., Ed.S., The University of Toledo

**Rao V. Nagisetty**, 1974, Professor emeritus, 2009

B.A., Andhra University India); Ph.D., Stekloff Institute

**Martin R. Pettet**, 1981, Professor emeritus, 2011

B.Sc., M.Sc., Toronto (Canada); M.Phil., Ph.D., Yale University

**Temoleon G. Rousos**, 1966, Professor emeritus, 1986

B.Ed., The University of Toledo; M.A.Ed., Eastern Michigan University; M.A., Mathematics,

Bowling Green State University; Ed.S., Ed.D., The University of Toledo

**Friedhelm Schwarz**, 1984, Professor emeritus, 2016

Diploma, University of Hanover (Germany); Ph.D., University of Bremen

**Stephen E. Spielberg**, 1963, Professor emeritus, 1993

B.A., University of Pennsylvania; M.A., Ph.D., University of Minnesota

**Stuart A. Steinberg**, 1971, Professor emeritus, 2009

B.A., Ph.D., University of Illinois; M.S., University of Chicago

**Gwen H. Terwilliger**, 1987, Associate professor emeritus, 2005

B.S., M.Ed., Bowling Green State University; Ph.D., The University of Toledo

**H. Westcott Vayo**, 1965, Professor emeritus, 2016

B.S., Culver - Stockton College; M.S., Ph.D., University of Illinois

**Henry C. Wente**, 1971, Distinguished university professor emeritus, 2009

A.B., A.M., Ph.D., Harvard University

**Denis White**, 1984, Professor emeritus, 2016

B.Sc., M.Sc., University of Toronto (Canada); M.S., Ph.D., Northwestern University

**Harvey E. Wolff**, 1975, Professor emeritus, 2010

B.A., University of Connecticut; M.A., Ph.D., University of Illinois

### **Retired Faculty**

**Mohamed S. El-Bialy**, 1990, Professor, 2013

Ph.D., University of Minnesota

**Donald J. Greco**, 1977, Professor, 2008

B.A., The Ohio State University; M.Ed., Ph.D., The University of Toledo



**L. Marie Hoover**, 1984, Associate professor, 2008  
B.A., Muskingum College; M.A., University of Michigan; Ph.D. The University of Toledo  
**Elaine I. Miller**, 1986, Associate professor, 2010  
A.S., Alpena College; B.S., M.A., Eastern Michigan University  
**Robert L. Ochs Jr.**, 1988, Associate professor, 2016 B.S., Ursinus College; M.S., The Pennsylvania State University; M.A., Ph.D., University of Delaware

### Lecturers

**Amrita Acharyya**, 2014, Lecturer  
B.S., M.S., M.A., University of Calcutta (India); Ph.D., The University of Alabama  
**Katherine Bryant**, 2010 Associate lecturer  
B.S., M.S., The University of Toledo  
**Jeongoo Cheh**, 2014, Lecturer  
B.S., Pohang University of Science and Technology (Korea); Ph.D., University of Minnesota  
**Zhiwei Chen**, 2011, Associate lecturer  
B.A. Central University of Finance and Economics (China); Ph.D., University of Maryland  
**Vani Cheruvu**, 2012, Associate lecturer  
M.Sc., M.Phil., University of Hyderabad (India), Ph.D., Indian Institute of Technology (India)  
**Katharine Fisher**, 2005, Senior lecturer  
B.S., Queen's University, (Canada); M.S., University of Calgary (Canada)  
**David Gajewski**, 2011, Associate lecturer  
B.S., M.S., Ph.D., The University of Toledo  
**Kevin Gibbs**, 2010, Associate lecturer  
B.S., M.A., Eastern Michigan University  
**Seung-Moon Hong**, 2011, Associate lecturer  
B.S., M.S., Hanyang University (South Korea), Ph.D., University of Indiana  
**Nathaniel Iverson**, 2011, Associate lecturer  
B.A., Simpson College, M.A., Ph.D., Bowling Green St. University  
**Paramasamy Karuppuchamy**, 2012, Associate lecturer  
B.Sc., M.Sc., Madurai Kamaraj University (India), Ph.D., University of Madras (India)  
**Gregory Lewis**, 2008, Associate lecturer  
B.S., Ohio University; M.Ed., M.S., The University of Toledo  
**Suzan Orra**, 2009, Associate lecturer  
B.S., M.S., The University of Toledo  
**Minhui Paik**, 2012, Associate lecturer  
B.S., Korea University (South Korea), M.S., Ph.D., Iowa State University  
**Sandra Robinson**, 2016 Lecturer  
B.A., M.A., Wayne State University  
**Matthew Sutherland**, 2011, Associate lecturer  
B.S., Heidelberg College, M.A., Bowling Green St. University  
**Sibylle Weck-Schwarz**, 2003, Senior lecturer  
Vordiplom., Diplom., Ph.D., University of Hannover (Germany)  
**Syed Zaidi**, 2003, Senior lecturer  
B.S., M.S., University of the Punjab (Pakistan) M.S., Emporia State University  
**Wenqi Zhao**, 2014, Lecturer  
B.S., Namkai University (China); M.S., Ph.D., University of Texas at Austin

### Retired Lecturers

**David Beekley**, 2004, Associate lecturer, 2010  
B.S.M.E., The University of Toledo; M.S.M.E., The University of Michigan  
**Chase Brady**, 2010, Associate lecturer, 2014  
B.A., New College of Florida; M.S., University of Alaska, Fairbanks; M.S., Miami University  
**Theresa Myers**, 2002, Senior lecturer, 2014  
B.A. SUNY College at Oneonta; M.Ed., The University of Toledo  
**Lawrence Shears**, 2002, Associate lecturer, 2010  
B.S., The University of Toledo; M.A.T., Brown University

**T. Munir Simon**, 2002, Senior lecturer, 2012  
B.S., The University of Toledo; M.B.A., Rutgers University  
**Edward Stelnicki**, 2002, Associate lecturer, 2011  
B.B.A., M.Ed, The University of Toledo

### **Department of Physics and Astronomy**

**Jacques G. Amar**, 1997, professor and associate chair  
M.A., University of Rochester; Ph.D., Temple University  
**Jon E. Bjorkman**, 1996, professor  
B.A., University of North Carolina-Chapel Hill; M.S., University of Colorado; Ph.D., University of Wisconsin  
**Karen S. Bjorkman**, 1996, Distinguished University Professor, Dean  
B.S., University of North Carolina-Chapel Hill; M.S., Ph.D., University of Colorado  
**Jillian Bornak**, 2013, lecturer  
B.A., Syracuse University; M.S., Ph.D., New Mexico State University  
**Rupali Chandar**, 2007, professor  
B.S., Haverford College, M.S., Ph.D., Johns Hopkins University  
**Song Cheng**, 1993, associate professor and graduate program director  
B.Sc., Changsha Institute of Technology; Ph.D., Kansas State University  
**Robert W. Collins**, 2004, Distinguished University Professor and NEG Endowed Chair of Silicate and Materials Science  
B.A., Clark University; M.S., Ph.D., Harvard University  
**Michael Cushing**, 2011, associate professor  
B.S. Boston University, M.S., Ph.D., University of Hawaii  
**Xunming Deng**, 1996, professor  
M.S., Ph.D., University of Chicago  
**Randall J. Ellingson**, 2008, professor  
B.A., Carleton College; M.S., Ph.D., Cornell University  
**Steven R. Federman**, 1988, professor  
B.S., Polytechnic Institute of Brooklyn; M.S., Ph.D., New York University  
**Bo Gao**, 1994, professor  
B.S., Zhejiang University; M.S., Ph.D., University of Nebraska  
**Michael J. Heben**, 2008, PVIC Endowed Professor  
B.S., John Carroll University; M.S., Stanford University; Ph.D., California Institute of Technology  
**Victor G. Karpov**, 2001, professor  
Ph.D., Leningrad Polytechnic Institute  
**Dileep Karanth**, 2015, lecturer  
Ph.D., University of Arkansas  
**Sanjay V. Khare**, 2004, professor and chair  
Ph.D., University of Maryland  
**Scott A. Lee**, 1987, professor and undergraduate adviser  
B.S., Bowling Green State University; M.S., Ph.D., University of Cincinnati  
**S. Thomas Megeath**, 2006, professor  
B.S., California Institute of Technology; Ph.D., Cornell University  
**Nikolas Podraza**, 2011, associate professor  
B.S., M.S., Pennsylvania State University, Ph.D., The University of Toledo  
**Kathy Shan**, 2012, lecturer  
B.S., Marshall University; M.S., Ph.D., The University of Toledo  
**J.D. Smith**, 2008, Professor  
S.B., Massachusetts Institute of Technology; M.S., Ph.D., Cornell University  
**Yanfa Yan**, 2011, Ohio Research Scholar professor  
B.S., M.S., Ph.D., Wuhan University

## **Emeritus Faculty**

**Lawrence S. Anderson-Huang**, 1978, professor emeritus, 2016

B.S., California Institute of Technology; M.A., Ph.D., University of California - Berkeley

**Brian G. Bagley**, 1991, professor emeritus, 2008

B.S., M.S., University of Wisconsin - Madison; A.M., Ph.D., Harvard University

**Randy G. Bohn**, 1969, professor emeritus, 2003

B.S.E.P., The University of Toledo; Ph.D., The Ohio State University

**Bernard W. Bopp**, 1974, professor emeritus, 2010

B.A., New York University; Ph.D., The University of Texas

**Alvin D. Compaan**, 1987, Distinguished University Professor emeritus, 2009

A.B., Calvin College; M.S., Ph.D., University of Chicago

**Larry J. Curtis**, 1963, Distinguished University Professor emeritus, 2006

B.S., The University of Toledo; M.S., Ph.D., University of Michigan

**Robert T. Deck**, 1965, professor emeritus, 1993

B.A., LaSalle College; Ph.D., University of Notre Dame

**Armand H. Delsemme**, 1966, professor emeritus, 1988

M.S., M.E., Ph.D., Universite de Liege

**David G. Ellis**, 1965, professor emeritus, 2006

A.B., Marietta College; Ph.D., Cornell University

**Philip B. James**, 1990, Distinguished University Professor emeritus, 2006

B.S., Carnegie Mellon University; Ph.D., University of Wisconsin

**Thomas J. Kvale**, 1986, professor and director of undergraduate research

B.A., Gustavus Adolphus College; M.S., Ph.D., University of Missouri - Rolla

**Nancy D. Morrison**, 1978, professor emeritus, 2010

B.A., Radcliffe College; M.S., Ph.D., University of Hawaii

**James F. Palmer**, 2000, professor

M.S., Cornell University; M.S., Eastern Michigan University; M.S., University of Florida

**Richard M. Schectman**, 1961, professor emeritus, 1986

B.S., Lehigh University; M.S., The Pennsylvania State University; Ph.D., Cornell University

**H. John Simon**, 1972, professor emeritus, 1999

B.S., Tufts University; M.A., Ph.D., Harvard University

**William Williamson Jr.**, 1965, professor emeritus, 1997

B.A., San Francisco State College; M.A., University of California; Ph.D., University of Colorado

**Adolf N. Witt**, 1967, Distinguished University Professor emeritus, 2006

Vordiplom, University of Hamburg; Ph.D., University of Chicago