

**GEOL 491 (Formerly GEY 491)  
Seminar**

Lectures in selected fields of geology. Subject of seminar and number of credits announced in class schedule for the semester course is offered. Prerequisite: Consent of instructor. 1-3 credits.

**GEOL 495 (Formerly GEY 493)  
Independent Study and Research**

Independent study and research projects in some field of geology. Open only to upper-division students. Proposed project for study and/or research must be submitted in writing to the department chair for approval and credit evaluation prior to registration. May be repeated to a maximum of six credits. Prerequisites: Upper-division student and consent of instructor. 1-3 credits.

**GEOL 496 (Formerly GEY 496)  
Advanced Topics in Geoscience**

Variety of advanced studies of current and/or topical interest in specialized areas of geoscience. May be repeated to a maximum of six credits. Prerequisite: Varies depending upon the specific topic. 1-3 credits.

**GEOL 497 (Formerly GEY 497)  
Senior Thesis**

Independent original research in geoscience. Requires a written thesis and an oral exam. Proposed project of study must be submitted in writing to the department chair and undergraduate coordinator at least two weeks prior to registration. 3 to 6 credits.

# Department of Mathematical Sciences

## ***Purpose and Focus***

The Department of Mathematical Sciences provides opportunities for learning and research in several fields of concentration. Mathematics provides the language and concepts in terms of which knowledge in almost all disciplines is understood and communicated, and it often provides the means and techniques for solving problems. The courses required in the various optional concentrations of the department's program serve several purposes which include helping students along paths leading to branches of science and technology as well as to mathematical specializations. These courses are designed to provide routes by which students may arrive at the research level in any of the special areas listed and to allow students to prepare themselves for work in industry or government or in educational institutions.

## ***Accreditation***

Northwest Commission on Colleges and Universities

## ***Degree Objectives/Learning Outcomes***

Upon completion of the bachelor's degree in mathematical sciences, students would have been trained to think analytically, would have rigorous problem-solving skills, and have a solid background to enable them to pursue graduate studies in mathematical sciences.

## ***Undergraduate Majors***

Mathematical Sciences - Bachelor of Arts  
Mathematical Sciences - Bachelor of Science

## ***Areas of Concentration***

Actuarial Sciences

## ***Minors***

A minor in the Department of Mathematical Sciences includes at least 20 credits in areas of concentrations as follows:

### **Actuarial Sciences**

Includes MATH 181, 182, 320, 330 or 365, 473, and 471.

### **Mathematics:**

Includes MATH 181, 182, 251 or 283, 330 or 365, and nine additional upper-division credits of MATH or STAT.

### **Statistics**

MATH 181, 182, 330 or 365, STAT 391 or 411 or 463 or 491, STAT 413 and 493.

No course in which a grade of C- or lower is earned may be applied to any minor in the College of Science.

## ***Admission to the Major***

GPA: 2.50

**Admissions Policies:** The department follows the admission policies of the College of Sciences.

**Advisement**

Each student is assigned a faculty advisor and is required to see the advisor at least once a year.

**Degree Requirements**

A grade of C or higher is required in each MATH or STAT course used to satisfy degree requirements for a major in mathematical sciences. At most, six credits of independent study may be used in any undergraduate degree program in mathematical sciences.

**Mathematical Sciences - B.A.**

- 1) English Composition ..... 6 credits  
ENG 101 and ENG 102
- 2) English Literature ..... 3 credits  
ENG 231 or 232
- 3) Constitutions ..... 3-6 credits
- 4) Mathematics ..... 3 credits
- 5) Distribution Requirement  
(Life & Physical Sciences & Analytical Thinking)  
Humanities and Fine Arts ..... 9 credits  
Social Science ..... 9 credits
- 6) Multicultural ..... (see notes)  
International ..... (see notes)
- 7) Degree Requirements:  
Computer Science courses ..... 6 credits
  
- Sciences ..... 9 credits  
Select from college-level BIOL, CHEM, GEOG, GEOL, PHYS, EGG, CEE, CS, EEG, ME courses.
  
- Required Department Courses ..... 60 credits  
MATH 181, 182, 251, 283, 330 or 365, 427, 451, 453, 455, 457, 459, 461, 483, 488, STAT 411, and 12 additional credits from upper-division MATH or STAT courses.
  
- Electives ..... 16-19 credits
- Total: ..... 124 credits

**Notes:**

1. Every student must complete a three-credit multicultural course and a three-credit international course. Courses satisfying other requirements may simultaneously satisfy the multicultural and international requirements except one course cannot satisfy both the multicultural and the international requirements.
2. Every student will be encouraged to take the GRE Advanced Test in Mathematics.
3. Students are required to include a two-semester college-level foreign language course in their course of study or have two years of any foreign language at the high school level.

**Mathematical Sciences - B.S.**

- 1) English Composition ..... 6 credits  
ENG 101 and ENG 102
- 2) English Literature ..... 3 credits  
ENG 231 or 232
- 3) Constitutions ..... 3-6 credits
- 4) Mathematics ..... 3 credits
- 5) Distribution Requirement  
(Life & Physical Sciences & Analytical Thinking)  
Humanities and Fine Arts ..... 9 credits  
Social Science ..... 9 credits
- 6) Multicultural ..... (see notes)  
International ..... (see notes)
- 7) Degree Requirements:  
Computer Science courses ..... 6 credits
  
- Sciences ..... 18 credits  
Select from the following:  
BIOL courses numbered 189 and above; CHEM courses numbered 121 and above except CHEM 201, 203; GEOL courses numbered 220 and above; GEOG courses numbered 300 and above; PHYS courses numbered 180 and above; EGG courses numbered 206 and above; CEE courses numbered 300 and above; CS courses numbered 218 and above; EEG courses numbered 208 and above; and all ME courses.
  
- Required Department Courses ..... 60 credits  
MATH 181, 182, 251, 283, 330 or 365, 427, 451, 453, 455, 457, 459, 461, 483, 488, STAT 411, and 12 additional credits from upper-division MATH or STAT courses.
  
- Electives ..... 7-10 credits
- Total: ..... 124 credits

**Notes:**

1. Every student must complete a three-credit multicultural course and a three-credit international course. Courses satisfying other requirements may simultaneously satisfy the multicultural and international requirements except one course cannot satisfy both the multicultural and the international requirements.
2. Every student will be encouraged to take the GRE Advanced Test in Mathematics.

**Mathematical Sciences - B.S.**

**Actuarial Science Concentration**

- 1) English Composition ..... 6 credits  
ENG 101 and ENG 102
- 2) English Literature ..... 3 credits  
ENG 231 or 232
- 3) Constitutions ..... 3-6 credits
- 4) Mathematics ..... 3 credits
- 5) Distribution Requirement  
(Life & Physical Sciences & Analytical Thinking)  
Humanities and Fine Arts ..... 9 credits  
Social Science ..... 9 credits
- 6) Multicultural ..... (see notes)  
International ..... (see notes)

- 7) Degree Requirements:  
 Computer Science courses ..... 3 credits  
 CS 117 or CS 135
- Sciences ..... 9 credits  
 Select from the following:  
 BIOL courses numbered 189 and above; CHEM courses numbered 121 and above except CHEM 201, 203; GEOG courses numbered 300 and above; PHYS courses numbered 180 and above; EGG courses numbered 206 and above; CEE courses numbered 300 and above; CS courses numbered 218 and above; EEG courses numbered 208 and above; and all ME courses.
- Finance ..... 9 credits  
 FIN 321, 420, 421
- Required Department Courses ..... 42 credits  
 MATH 181, 182, 283, 330 or 365, 320, 427, 463 or 466, 473, 471, and STAT 411, 413, 467, and 488.
- Electives ..... 25-28 credits  
 Total: ..... 124 credits

**Notes:**

1. Of the 124 credits required for graduation, 80 or more must be in courses offered by the College of Sciences and the College of Engineering.
2. Every student must complete a three-credit multicultural course and a three-credit international course. Courses satisfying other requirements may simultaneously satisfy the multicultural and international requirements except one course cannot satisfy both the multicultural and the international requirements.

**Note Concerning Mathematics Preparation.** It is possible for students having fewer than three years of high school mathematics to be admitted to UNLV. However, the limited resources available to the Department of Mathematical Sciences make it impossible to offer remedial classes for such students except in the Summer Term. Students who do not have the mathematics skills required for MATH 096 may take MATH 095 offered during the Summer Term. Other possibilities are to take non-credit classes in mathematics from UNLV's Division of Educational Outreach or from the Community College of Southern Nevada. Students who have had calculus in high school should consult the Mathematical Sciences Department for advanced placement. (A high school course in plane geometry will be very helpful to students planning to complete a sequence of courses in Mathematical Sciences.)

**Note Concerning Prerequisites.** MATH 096, 120, 122, 124, 126, 127, 128, 132, 170, 176, and 181 are entry-level courses. The prerequisite for each is: three units of high school mathematics at the level of algebra and above and the UNLV required score on the SAT or ACT Placement Test(s) or the prerequisite mathematics course listed. To register in subsequent MATH/STAT courses, a grade of C (2.00) or higher is required in all prerequisite courses.

If no prerequisite is mentioned, consent of the instructor is needed. The Department of Mathematical Sciences will waive these prerequisites only if the student's record gives evidence that satisfactory performance is probable.

**Note Concerning Duplicate Credit.** Duplicate credits cannot be earned in any two of:

- |                       |                  |
|-----------------------|------------------|
| a) MATH 124, 126, 128 | d) MATH 330, 365 |
| b) MATH 127, 128      | e) MATH 427, 431 |
| c) MATH 176, 181      | f) STAT 411, 491 |

**Mathematics**

**MATH 095**

**Elementary Algebra**

Elementary algebraic topics for students whose mathematical background or placement score indicates that preparation for Intermediate Algebra is desirable. Credit for this course does not count toward the total needed for graduation. Prerequisite: Arithmetic skills required. 3 credits.

**MATH 096**

**Intermediate Algebra**

Polynomial and rational expressions, linear equations, linear and absolute value inequalities, applications, exponents and radicals, quadratic equations, relations, and their graphs, systems of equations. Credit for this course does not count toward the total needed for graduation. Prerequisites: Three years of high school mathematics, including one year of algebra, and a satisfactory score on the Math Placement Test. 3 credits.

**MATH 115**

**Humane Mathematics**

Study of some elementary and elegant examples displaying mathematics as a medium for artistic expression and aesthetic appreciation. Intended for students with limited mathematical background, but not preparation for college algebra or the precalculus mathematics sequence. Does not satisfy the general education core mathematics requirement. Prerequisite: One year of high school algebra. 3 credits.

**MATH 120**

**Fundamentals of College Mathematics**

Real numbers; consumer mathematics; variation; functions, relations, and graphs; geometry of measurement; probability and statistics; sets and logic. Broad in scope course, emphasizes applications. Prerequisites: Three years of high school mathematics at the level of algebra and above, and a satisfactory score on the Math Placement Test. 3 credits.

**MATH 122**

**Number Concepts for Elementary School Teachers**

Mathematics needed by those teaching the new-content curriculum at the elementary school level, emphasis on number concepts. MATH 122 does not satisfy the general education core mathematics requirement. Prerequisite: MATH 096. 3 credits.

**MATH 123****Statistical and Geometrical Concepts for Elementary School Teachers**

Mathematics needed by those teaching the new-content curriculum at the elementary school level, emphasizing concepts in statistics and geometry. Prerequisite: MATH 122. 3 credits.

**MATH 124\*****College Algebra**

Equations and inequalities; relations and functions; linear, quadratic, polynomial, exponential, and logarithm functions; systems of linear equations and inequalities; matrices; sequences and series; binomial theorem. Prerequisites: Three years of high school mathematics at the level of algebra and above, and a satisfactory score on the Math Placement Test or MATH 096 or equivalent. 3 credits.

**MATH 126\*****Precalculus I**

Topics include fundamentals of algebra, functions and graphs, polynomial, rational, exponential, and logarithmic functions, and systems of linear equations. Prerequisites: Three years of high school mathematics at the level of algebra and above, and a satisfactory score on the Math Placement Test or MATH 096 or equivalent. 3 credits.

**MATH 127\*****Precalculus II**

Topics include circular functions, trigonometric identities and equations, conic sections, complex numbers, and discrete algebra. Prerequisites: Three years of high school mathematics at the level of algebra and above, and a satisfactory score on the Math Placement Test or MATH 126. 3 credits.

**MATH 128\*****Precalculus and Trigonometry**

Relations, functions, and their graphs; polynomial, rational, exponential, logarithm, and trigonometric functions; analytic trigonometry; systems of equations and inequalities; conics; mathematical induction; sequences and series. A combination of MATH 126 and MATH 127. Prerequisites: Four years of high school mathematics at the level of algebra and above, and a satisfactory score on the Math Placement Test or MATH 096 or equivalent. 5 credits.

**\*Duplicate credits cannot be earned in any two of MATH 124, 126, and 128 or MATH 127 and 128.**

**MATH 132****Finite Mathematics**

Logic, sets, probability, matrices, and linear programming, and their application to the analysis of business and social science problems. Prerequisites: MATH 124 or MATH 126 or equivalent. 3 credits.

**MATH 170****Mathematics of Finance**

Mathematical study of interest, annuities, sinking funds, depreciation, amortization, and other topics related to business problems. Prerequisite: MATH 124 or equivalent. 3 credits.

**MATH 176\*\*****Introductory Calculus for Business and Social Sciences**

Techniques of calculus, with applications to the analysis of business and social science problems. Topics include functions of one and several variables, differentiation and partial differentiation, integration, and optimization. Prerequisites: MATH 124 or MATH 126 or equivalent. 3 credits.

**MATH 181\*\*****Calculus I**

Differentiation and integration of algebraic and transcendental functions, with applications. Prerequisite: MATH 128 or equivalent. 4 credits.

**\*\*Duplicate credits cannot be earned in any two of MATH 176 and 181.**

**MATH 182****Calculus II**

Further applications and techniques of integration including integration by parts, sequences and series, polynomial approximations. Prerequisite: MATH 181. 4 credits.

**MATH 213****Introduction to Problem Solving Techniques**

Analyzing and solving standard and non-standard problems using a variety of different problem-solving techniques, tools, and technology. Emphasizes different approaches to solving problems and complete oral and/or written explanations of how to solve the problems. Prerequisite: MATH 122. 3 credits.

**MATH 214****Geometry for Middle School Teachers**

Study of one- two- and three-dimensional geometry, including figures, properties, and transformations, using classical and analytical methods. Emphasis on developing an appreciation for the widespread use of geometry and using geometry to solve problems. Prerequisite: MATH 123. 3 credits.

**MATH 251****Discrete Mathematics I**

Topics include set operations, Cartesian product relations and functions, equivalence relation, graphs and digraphs, propositional calculus, truth tables, mathematical induction, elementary combinatorics with applications to probability. Corequisite: MATH 182. 3 credits.

**MATH 271****Elementary Probability**

Review of sets, counting, finite and countable probability spaces, random variables and distribution functions, statistical quantities, limit theorems, applications. Prerequisite: MATH 182 or equivalent. 3 credits.

**MATH 283****Calculus III**

Vectors; differentiation and integration of vector valued functions; multivariable calculus; partial derivatives; multiple integrals and applications; line, surface and volume integrals; Green's theorem; divergence theorem; and Stoke's theorem. Prerequisite: MATH 182. 4 credits.

**MATH 313****Probability and Combinatorics for Teachers**

Topics include sets, functions, relations, propositional logic, induction, elementary combinatorics, and elementary graph theory. Prerequisite: MATH 181 and 213, or MATH 182. 3 credits.

**MATH 314****History of Mathematics**

Evolution of mathematics from ancient numeral systems to twentieth-century mathematics. Effects of culture on mathematics and impact of mathematics on cultures also considered. Prerequisites: MATH 313 or MATH 330. 3 credits.

**MATH 320****Mathematics of Interest**

Introduction to the mathematical theory underlying the measurement of interest, accumulated and present values, annuities, amortization, sinking funds, bonds, and securities. Prerequisites: MATH 182 and MATH 330. 3 credits.

**MATH 330****Linear Algebra**

Introduction to linear algebra, including matrices and linear transformations, eigenvalues and eigenvectors. Credit not awarded for both MATH 330 and MATH 365. Prerequisite: MATH 182. 3 credits.

**MATH 351****Discrete Mathematics II**

Infinite sets, Cantor's diagonal argument, first order logic, formal and informal proofs, combinatorics, Boolean algebra, lattices, and graphs. Prerequisites: MATH 251 and MATH 330. 3 credits.

**MATH 365****Computational Linear Algebra**

Matrices, linear systems of equations, linear programming, least-squares approximations, determinants, eigenvalues and eigenvectors, matrix inversion, elimination, iteration and other algorithms, precision and error analysis, of computational cost of algorithms. Emphasizes the practical methods using computer algorithms. Credit not awarded for both MATH 330 and MATH 365. Prerequisites: MATH 182 and CS 117 or CS 135. 3 credits.

**MATH 427-428\*\*****Differential Equations I and II**

Theory and solution techniques for solving ordinary differential equations with constant and variable coefficients, systems of linear differential equations, Laplace transform, difference equations and numerical methods. Fourier Series; stability theory and autonomous systems. Prerequisites: MATH 330 and MATH 283. 3 credits each.

**MATH 431\*\*****Mathematics for Engineers and Scientists I**

First order linear and non-linear differential equations, second and higher order differential equations with constant coefficients, Laplace transforms and applications, Gaussian elimination and eigenvalue problems, solutions of systems of differential equations. Prerequisite: MATH 283. 3 credits.

**MATH 432\*\*****Mathematics for Engineers and Scientists II**

Topics include line and surface integrals, complex functions, complex integration, power series, Laurent series, calculus of residues, conformal mappings, linear fractional transformations, probability theory, random variables, random samplings, sample mean and variance. Prerequisite: MATH 283 or equivalent. 4 credits.

**\*\*Duplicate credits cannot be earned in any two of MATH 427-428 and MATH 431-432.**

**MATH 451****Foundations of Mathematics I**

Introduction to logic, set algebra and Boolean algebra, with applications to the theory of computing machines. Prerequisite: MATH 251 or MATH 330. 3 credits.

**MATH 452****Foundations of Mathematics II**

Formalization, proofs, and models of quantificational logic; axiomatics; application to mathematical theories, including set theory. Prerequisite: MATH 451. 3 credits.

**MATH 453-454****Abstract Algebra I and II**

Sets, functions, groups, quotient groups, homomorphism theorems, Abelian groups, rings, polynomial rings, division rings, Euclidean domains, fields and vector spaces. Prerequisites: MATH 251 and MATH 330. 3 credits each.

**MATH 455-456****Elementary Theory of Numbers I and II**

Topics include divisibility, arithmetic functions, congruences, quadratic residues, primitive roots, Diophantine equations, continued fractions, algebraic numbers, partitions. Prerequisite: MATH 330. 3 credits.

**MATH 457****Introduction to Real Analysis I**

Topics include finite and infinite sets, axiomatic study of real numbers, topology of Cartesian spaces, sequences of functions, continuous functions, differentiation of functions of one variable. Prerequisites: MATH 251, MATH 330 and MATH 283 or equivalent. 3 credits.

**MATH 458****Introduction to Real Analysis II**

Topics include uniform continuity and fixed point theorems, sequences of continuous functions, approximation theorems, Riemann-Stieltjes integral, uniform convergence and infinite integrals, series of functions, differentiation in  $\mathbb{R}^n$ . Prerequisite: MATH 457. 3 credits.

**MATH 459****Elementary Complex Analysis**

Complex numbers, analytic functions, contour integration, conformal mapping, applications. Prerequisites: MATH 251, MATH 330 and MATH 283 or equivalent. 3 credits.

**MATH 461****Probability Theory**

Fundamental concepts of probability; random variables, binomial, Poisson, normal, chi-square, T, F and other distributions; transformations of random variables; conditional and marginal distributions; central limit theorem and concepts associated with the field of statistics. Prerequisites: MATH 271 and MATH 283. 3 credits.

**MATH 462****Stochastic Processes**

Markov chains and jump processes, elements of queuing theory, stationary stochastic processes, the Wiener process and stochastic differential equations. Prerequisite: MATH 461. 3 credits.

**MATH 463****Advanced Matrix Theory and Applications**

Rigorous mathematical treatment of orthogonal matrices, Gram-Schmidt method, Q-R factorization, least-squares fits, eigenvalues and eigenvectors, linear difference equations, systems of linear differential equations, unitary similarities, Schur's theorem, discrete Markov processes, power method, quadratic forms, singular value decompositions, pseudo-inverse, systems of linear inequalities, and simplex method. Prerequisite: MATH 330. 3 credits.

**MATH 466****Numerical Methods I**

Introduction to numerical mathematics and scientific computing. Topics including methods of error estimation, interpolation theory, numerical integration, and solutions of linear and non-linear equations. Emphasizes hands-on computer work based on these techniques. Prerequisites: MATH 182, CS 136, or equivalent; MATH 330 or MATH 365. 3 credits.

**MATH 467****Numerical Methods II**

Intermediate treatment of methods in computational linear algebra, numerical solutions of ordinary and partial differential equations, algorithmic design and analysis, and topics selected by the instructor. Prerequisites: MATH 466, and MATH 427 or MATH 429 or equivalent. 3 credits.

**MATH 468****Applied Finite Element Analysis**

Introduction to the finite element method with computer applications to engineering continuum problems such as thermodynamics, solid and fluid mechanics, discretization of the domain, linear, quadratic, and higher polynomial approximations, linear, triangular, tetrahedral, and other elements, introduction to Galerkin's method. Prerequisite: MATH 431. 3 credits.

**MATH 469****Combinatorics I**

Graph models, covering circuits, graph colorings, trees and searching, general counting methods for arrangements and selections, generating functions, recurrence relations, and inclusion-exclusion. Prerequisite: MATH 251 or equivalent. 3 credits.

**MATH 470****Combinatorics II**

Advanced topics in combinatorics. Topics to be selected by the instructor. Prerequisite: MATH 469 or equivalent. 3 credits.

**MATH 471****Actuarial Mathematics I**

Rigorous mathematical treatment of the following topics: survival distributions, life tables, life insurance, life annuities, net premiums, reserves. Prerequisites: MATH 320 and STAT 411 or equivalent. 3 credits.

**MATH 472****Actuarial Mathematics II**

Rigorous mathematical treatment of the following topics: multiple life functions, multiple decrement models, valuation theory for pension plans, insurance models, nonforfeiture benefits, dividends. Prerequisite: MATH 471. 3 credits.

**MATH 473****Risk Theory**

Rigorous mathematical treatment of the following topics: insurance, individual risk models for short term, collective risk models, applications of risk theory. Prerequisite: STAT 411. 3 credits.

**MATH 480****College Geometry**

Study of advanced geometrical topics using the methods of proof of elementary geometry. Prerequisite: MATH 181. 3 credits.

**MATH 483-484****General Topology I and II**

Topological spaces, nets and filters, compactness, continuous functions, product and quotient spaces, introduction to algebraic topology. Prerequisites: MATH 251, MATH 330 or equivalent. 3 credits each.

**MATH 488****Partial Differential Equations**

Method of separation of variables, Fourier series, divergence theorem and Green's identities, equations of mathematical physics, initial and initial boundary value problems, well-posedness, heat conduction in a thin rod, vibrations of a string, Laplace's equation, solution of the Dirichlet problem for a disc and for a rectangle. Prerequisite: MATH 427 or MATH 431. 3 credits.

**MATH 489****Advanced Mathematical Topics**

Undergraduate-level course in advanced topics of mathematics, depending upon the interest of faculty and students. May be repeated to a maximum of six credits. Prerequisite: MATH 283 or equivalent. 3 credits.

**MATH 499****Independent Study**

Library research and reports on topics of mathematical interest. May be repeated for credit with consent of Mathematical Sciences Department. Except under special circumstances, total credits limited to six. Prerequisite: MATH 283. 1-3 credits.

**Statistics****STAT 152****Introduction to Statistics**

Basic statistical methods, with emphasis on application, descriptive statistics, graphic presentation, point and interval estimation, hypothesis testing, regression, experimental design. Prerequisite: MATH 126 or equivalent. 3 credits.

**STAT 391****Applied Statistics for Biological Sciences**

Elements of probability, types of biological data, sampling, graphical display of data, commonly used distributions, sampling distributions, point estimations, interval estimation, testing of hypothesis, nonparametric tests, categorical data analysis, introduction to regression and design of experiments. Prerequisite: MATH 127 or equivalent. 3 credits.

**STAT 411\*****Statistical Methods I**

Collection and representation of information; elements of probability; Bernoulli trials, hypergeometric, binomial, Poisson and normal distributions; statistical sampling, estimation; testing hypotheses; parametric procedures for one-sample and two-sample problems. Prerequisite: MATH 182. 3 credits.

**STAT 412****Statistical Methods II**

Regression analysis; importance and essentials of statistically designed experiments, completely randomized design, randomized block design, factorial design, statistical quality control. Prerequisite: STAT 411. 3 credits.

**STAT 413****Statistical Experimental Design**

Fundamental principles of analysis of variance; one-way, two-way, and higher order designs; nested designs; randomized blocks; split plot designs; Latin squares; multiple comparisons; and analysis of covariance. Prerequisite: STAT 411. 3 credits.

**STAT 463****Applied Statistics for Engineers**

Elementary probability, commonly used discrete and continuous probability distributions, estimation and hypothesis testing, categorical data testing, regression, model building, analysis of variance, product and system reliability and engineering applications, and quality control. Prerequisites: MATH 283. 3 credits.

**STAT 467****Introduction to Mathematical Statistics**

Introduction to statistical inference, distributions of random variables, common discrete and continuous probability models, transformations limiting distributions, sufficiency, completeness, unbiasedness, the information inequality, unbiased estimation, the methods of moments, maximum likelihood estimation, Bayesian estimation, confidence intervals, hypothesis testing, uniformly most powerful tests, likelihood ratio tests and related procedures, linear models, and non-parametric models. Prerequisite: STAT 411 or equivalent. 3 credits.

**STAT 469****Environmental Statistics I: Univariate Methods**

Principles of environmental sampling, testing for outliers, tests for normality, transformations for normality, sample size determinations, analysis of censored data, estimation of background contaminations, tolerance and confidence limits, calibration problem, quality control charts for data quality assessment of environmental data, statistical issues in environmental remediation, and probability of hot spot detection. Usage of statistical software packages. Prerequisite: STAT 411 or equivalent. 3 credits.

**STAT 488****Senior Research Project in Statistics**

Special problem in an area of statistics for investigation and report. Prerequisites: STAT 411 or equivalent. 3 credits.

**STAT 489****Advanced Statistics Topics**

Undergraduate course in advanced topics in statistics, depending upon the interest of faculty and students. May be repeated to a maximum of six credits. Prerequisite: STAT 411 or equivalent. 3 credits.

### **STAT 491\***

#### **Statistics for Scientists I**

Frequency distributions, descriptive statistics, elementary probability; Bernoulli, binomial, and normal distributions; statistical sampling, estimation, and hypothesis testing. Less mathematical treatment than STAT 411. Prerequisite: MATH 127 or MATH 128 or equivalent. 3 credits.

**\*Duplicate credits cannot be earned in any two of STAT 411 and 491**

### **STAT 492**

#### **Statistics for Scientists II**

Chi-square tests for goodness-of-fit and independence, simple and multiple linear regression, designing an experiment (analysis of variance), multiple comparison. Less mathematical treatment than STAT 412. Prerequisites: STAT 152 and consent of instructor or STAT 467 or STAT 491. 3 credits.

### **STAT 493**

#### **Applied Regression Analysis**

Line fitting; multiple linear and curvilinear regression models; variable selection techniques and examination of residuals, estimation, testing, and prediction; simple, multiple, and partial correlation. Prerequisites: STAT 152 and consent of instructor or STAT 411, STAT 467 or STAT 491. 3 credits.

### **STAT 495**

#### **Nonparametric Statistics**

Survey of nonparametric procedures with emphasis on application; binomial, Mann-Whitney, Wilcoxon, Kruskal-Wallis, Friedman, Kolmogorov-Smirnov, and chi-square tests; measures of association; regression. Comparisons with parametric techniques. Prerequisites: STAT 152 and consent of instructor or STAT 411 or STAT 467 or STAT 491. 3 credits.

### **STAT 499**

#### **Independent Study**

Library research and reports on topics of statistical interest. May be repeated for credit with consent of the Mathematical Sciences Department. Except under special circumstances, total credits limited to six. Prerequisite: STAT 411 or equivalent. 1-3 credits.

## **Department of Physics**

### ***Purpose and Focus***

The Bachelor of Science in Physics provides students with preparation for governmental or industrial positions or for graduate studies in physics or related areas. The Bachelor of Science in Applied Physics is designed to introduce the major branches of physics to those seeking double degrees and for those preparing for professions other than physics. The Bachelor of Science in Computational Physics is intended to train students with the state-of-the-art knowledge in physics and scientific computing for either professional positions or graduate studies in computational physics or related areas.

### ***Degree Objectives/Learning Outcomes***

At the completion of the physics degree programs, students should have developed rigorous communication, analytical, computing, problem solving, and team-work skills.

### ***Accreditation***

Northwest Commission on Colleges and Universities.

### ***Undergraduate Majors***

Applied Physics  
Computational Physics  
Physics

### ***Minor Physics***

Includes PHYS 180, 180L, 181, 181L, 182, 182L, 411, 413, and nine additional credits (three courses) of upper-division physics course work.

No course in which a grade of C- or lower is earned may be applied to any minor in the College of Sciences.

### ***Admission to the Major***

GPA: 2.50

**Admission Policies:** Students unable to meet the 2.50 GPA requirement may be admitted under contract on a probationary basis and no students with GPAs less than 2.30 will be admitted.

**Transfer Policies:** A student transferring from another college or university who declares a major in Physics, Applied Physics, or Computational Physics with a GPA between 2.30 and 2.50 may become a probationary student. A probationary student must plan a prescribed course of study in physics in consultation with the faculty advisor assigned by the Physics Department. Only after the course of study is signed by the advisor, may the department chair allow the student to register for courses. The student must maintain a GPA of at least 2.50 in the courses taken while on probation. Otherwise, the student will be dropped from the physics program. When the student's overall GPA rises to 2.50, the student is taken off probation. Refer to the College of Sciences section for further requirements.