Mathematics

See Mathematics; and Applied Mathematics (A Graduate Group), on page 176.

Mathematics

[College of Letters and Science]
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(Molecular and Cellular Biology)
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Craig Benham, Ph.D., Professor
Joseph Biello, Ph.D., Professor
James Bremer, Ph.D., Associate Professor
Angela Y. Cheer, Ph.D., Professor
Tudor Dimofte, Ph.D., Assistant Professor
Jesus De Loera, Ph.D., Professor
C. Albert Fannjiang, Ph.D., Professor
Roland Freund, Ph.D., Professor
Michael P. Friedlander, Ph.D., Professor
Eugene Gorsky, Ph.D., Assistant Professor
Janko Gravner, Ph.D., Professor
Niels Gronbech-Jensen, Ph.D., Professor (Mechanical Engineering)
Robert Guralnik, Ph.D., Professor
Joel Hass, Ph.D., Professor
John K. Hunter, Ph.D., Professor
Adam J. Jacob, Ph.D., Assistant Professor
Michael Kapovich, Ph.D., Professor
Matthias Koecke, Ph.D., Professor
Gregory J. Kuperberg, Ph.D., Professor
Timothy Lewis, Ph.D., Professor
Fu Li, Ph.D., Professor
Kevin Liu, Ph.D., Assistant Professor
Ben Morris, Ph.D., Professor
Mohitika Mulase, Ph.D., Professor
Academic Senate Distinguished Teaching Award
Bruno I. Nachtergaele, Ph.D., Professor
Brian Osserman, Ph.D., Professor
E. Gerry Puckett, Ph.D., Professor
Dan Romik, Ph.D., Associate Professor
Naoki Saito, Ph.D., Professor
Anne Schilling, Ph.D., Professor
Jennifer Schultens, Ph.D., Professor
Albert Schwarz, Ph.D., Professor
Steve Shkoller, Ph.D., Professor
Alexander Soshnikov, Ph.D., Professor
Thomas Strohmer, Ph.D., Professor
J. Blake Temple, Ph.D., Professor
UC Davis Distinguished Professor 2012
Becca Tomasses, Ph.D., Associate Professor
Abigail Thompson, Ph.D., Professor
Academic Senate Distinguished Teaching Award
Craig A. Tracy, Ph.D., Professor
Monica Vazirani, Ph.D., Professor
Mariel Vazquez, Ph.D., Professor (Microbiology and Molecular Genetics)
Samuel Walcott, Ph.D., Associate Professor
Andrew Waldron, Ph.D., Professor
Qingxin Xia, Ph.D., Professor

Emerti Faculty
David Barnett, Ph.D., Professor Emeritus
Donald C. Benson, Ph.D., Professor Emeritus
Carlos R. Berg, Ph.D., Professor Emeritus
Robert J. Buck, Professor Emeritus
Gubbank D. Chakerian, Ph.D., Professor Emeritus
Academic Senate Distinguished Teaching Award
Doyle O. Culler, Ph.D., Professor Emeritus
James R. Diederich, Ph.D., Professor Emeritus
Dmitry B. Fuchs, Ph.D., Professor Emeritus
Robert D. Glaz, Ph.D., Professor Emeritus
Kurt Kreith, Ph.D., Professor Emeritus
Arthur J. Krener, Ph.D., Professor
Melven R. Krom, Ph.D., Professor Emeritus
Gary J. Kurovski, Ph.D., Professor Emeritus
David G. Mead, Ph.D., Professor Emeritus
Academic Senate Distinguished Teaching Award
E. O. Milton, Ph.D., Professor Emeritus
Academic Senate Distinguished Teaching Award
Alexander I. Mogilner, Ph.D., Professor Emeritus
Donald A. Norton, Ph.D., Professor Emeritus
Washek F. Pfeffer, Ph.D., Professor Emeritus
G. Thomas Sallee, Ph.D., Professor
Academic Senate Distinguished Teaching Award
Sherman K. Stein, Litt.D. (Hon.), Ph.D., Professor Emeritus
Academic Senate Distinguished Teaching Award
Howard J. Weiner, Ph.D., Professor Emeritus
Roger Wets, Ph.D., Professor Emeritus

Affiliated Faculty
Ali Dad-dl, Ph.D., Lecturer
Academic Federation Excellence in Teaching Award
Duane Koub, Ph.D., Lecturer
Lawrence Marx, Ph.D., Lecturer

The Major Programs
Mathematics is the study of abstract structures, space, change, and the interrelations of these concepts. It is also the language of the exact sciences.

The Program.
Students majoring in mathematics may follow a program leading to either the Bachelor of Arts or the Bachelor of Science degree. After completing basic introductory courses such as calculus and linear algebra, students plan an upper division program in consultation with a faculty adviser. The upper division course offering is grouped into entry level, core, and enrichment areas. Entry level courses are designed to serve as a bridge between the concrete mathematics of the lower division and the more abstract concepts taught in upper division courses. The core courses are intended to provide basic mathematical techniques, whereas the enrichment choices allow students to further mathematical knowledge and skills that feature their research or career interests. This individualized program can lead to graduate study in pure or applied mathematics, elementary or secondary level teaching, or to other professional goals. It can also reflect a special interest such as complex and applied mathematics, computer science, or statistics, or may be combined with a major in some other field.

Career Alternatives. A degree in mathematics provides entry to many careers in addition to teaching. For instance, operations research, systems analysis, computing, actuarial work, insurance, and financial services are only a few such careers. Mathematics is also a sound basis for graduate work in a variety of fields, such as law, engineering, and economics.

A.B. Major Requirements:

Preparatory Subject Matter ............... 43-50
Mathematics 12 (or high school equivalent) .................. 0-3
One of the following two options: (a) Mathematics 22A and 108 OR (b) Mathematics 67 .................................................. 47
Computer Science 30 or Engineering 4 .................. 4
Mathematics 22A or equivalent MATLAB knowledge .................. 0-1
Additional non-Mathematics courses chosen from natural sciences .................. 12
NOTE: Basic knowledge of MATLAB is required for both Mathematics 67 and 22A. Students can learn it on their own, enroll in Engineering 6, Mathematics 41, or take the one unit course Mathematics 22A (can be taken concurrently).

Depth Subject Matter .................. 37-42
A. Entry Level (Optional) ............... 0-4
Suggested choice; one course from:
Mathematics 108, 114, 115A, 141, 145 .................. 4-8
B. Core .................. 16
Mathematics 125A .................................. 4
Mathematics 125B .................................. 4
Mathematics 135A .................................. 4
Mathematics 150A .................................. 4
C. Choose one Plan from the following two; up to 4 of these 18 units may be approved upper division courses outside of the Department of Mathematics with extensive use of mathematics .................. 18
Plan 1: General Mathematics

Additional upper division mathematics units selected in consultation with and subject to approval of an adviser .................. 18
Plan 2: Secondary Teaching Mathematics 111 .................................. 4
Mathematics 115A .................................. 4
Mathematics 141 .................................. 4
Additional upper division mathematics units selected in consultation with and subject to approval of an adviser .................. 6
NOTE: Students who wish to satisfy the single subject matter waiver for the teaching credential should see an adviser as early as possible.
D. Capstone Course: Mathematics 189 or 192 (Internship in any Math Major), or 204 (Undergraduate Thesis) or 180 (Special Topics) or an approved substitute in consultation with the Undergraduate Vice Chair .................. 3-4

Fall 2011 and on Revised General Education (GE) AJ AH–Arts and Humanities; SE–Science and Engineering; SS–Social Sciences; AGCH–American Cultures; DO–Diverse Cultures; OL–Oral Skills; OLQ–Quantitative; SL–Scientific; VL–Visual; WC–World Cultures; WE–Writing Experience
Pre-Fall 2011 General Education (GE): AH–Arts and Humanities; SE–Science and Engineering; SS–Social Sciences; DO–Diverse Cultures; OL–Oral Skills; OLQ–Quantitative; SL–Scientific; VL–Visual; WC–World Cultures; WE–Writing Experience
Quarter Offered: F–Fall; W–Winter; S–Spring; 3u–Summer; 2017-2018 offering in parentheses
Total Units for the Major.................. 80-92

Applied Mathematics

B.S. Major Requirements:

Preparatory Subject Matter ............42-52
Mathematics 12 (or high school equivalent) .................................0-3
One of the following two options:  
(a) Mathematics 22A and 108 OR (b) Mathematics 67 .................................4-7
Mathematics 125A, or equivalent basic knowledge of MATLAB ..................0-1
Computer Science 30, 40 .........................................................8
One two-quarter sequence from Physics 9A-9B, Biological Sciences 2A-2B, Chemistry 2A-2B, Economics 1A-1B, Statistics 32, 100; or other applied preparatory courses approved by your adviser ........................................7-10

NOTE: Basic knowledge of MATLAB is required for both Mathematics 67 and 22A. Students can learn it on their own, enroll in Engineering 6, Mechanical Engineering 5 or in the one unit course Mathematics 22AL (can be taken concurrently).

Depth Subject Matter ..........................51-56

A. Entry Level (Optional) ....................0-4
Suggested choice; one course from: Mathematics 108, 114, 115A, 141, 145

B. Core ..............................................28
Mathematics 125A ..............................................4
Mathematics 135A ..............................................4
Mathematics 125A ..............................................4
Mathematics 119A ..............................................4
Mathematics 185A ..............................................4

Choice any two from the following: Mathematics 125A, 128B, 128C ..............................................8

C. Enrichment Courses .......................16
1. Choice of three courses from: Mathematics, between Mathematics 111 and Mathematics 185B (excluding Mathematics 180) worth at least four units each ...................................................................................12
2. One approved upper division course outside the Department of Mathematics with extensive use of mathematics ........................................4

D. Capstone Course: Mathematics 189 or 192 (Internship in Applied Mathematics or 194 (Undergraduate Thesis) or 180 (Special Topics) or an approved substitute in consultation with the Undergraduate Vice Chair .......................................3-4

Plan 2: Mathematics for Secondary Teaching

A. Entry Level (Optional) ....................0-4
Suggested choice; one course from: Mathematics 108, 114, 145

B. Core ..............................................28
Mathematics 125A ..............................................4
Mathematics 135A ..............................................4
Mathematics 125A ..............................................4
Mathematics 119A ..............................................4
Mathematics 185A ..............................................4

Choice any two from the following: Mathematics 111, 125A, 125B, 128B, 128C ..............................................8

C. Enrichment Courses .......................16
1. Choice of five courses from Mathematics, between Mathematics 111 and Mathematics 185B (excluding Mathematics 180) worth at least four units each. Up to four units can be approved upper division units outside the Department of Mathematics with extensive use of mathematics.

D. Capstone Course: Mathematics 189 or 192 (Internship in Applied Mathematics) or 194 (Undergraduate Thesis) or 180 (Special Topics) or an approved substitute in consultation with the Undergraduate Vice Chair .......................................3-4

Total Units for the Major ................94-105

Mathematics

B.S. Major Requirements:

Preparatory Subject Matter ............43-50
Mathematics 12 (or high school equivalent) .................................0-3
One of the following two options:  
(a) Mathematics 22A and 108 OR (b) Mathematics 67 .................................4-7
Mathematics 22AL or equivalent basic knowledge of MATLAB ...............0-1
Computer Science 30 .........................................................8
Economics 32 or 100 .........................................................8
NOTE: Basic knowledge of MATLAB is required for both Mathematics 67 and 22A. Students can learn it on their own; enroll in Engineering 6, Mechanical Engineering 5, or in the one unit course Mathematics 22AL (can be taken concurrently).

Depth Subject Matter ..........................51-56

A. Entry Level (Optional) ....................0-4
Choices: 1 course from Mathematics 108, 114, 115A, 141, 145

B. Core ..............................................28
Mathematics 125A ..............................................4
Mathematics 135A ..............................................4
Mathematics 125A ..............................................4
Mathematics 119A ..............................................4
Mathematics 185A ..............................................4

Choice any two from the following: Mathematics 111, 125A, 125B, 128B, 128C ..............................................8

C. Enrichment Courses .......................16

D. Choose one Emphasis from the following two:  
(a) Computational and Mathematical Biology Emphasis  
(b) Computational and Mathematical Emphasis
Mathematics 124 ..............................................4
One approved upper division course in Biology ...........................................4

E. Capstone Course: Mathematics 189 or 192 (Internship in Applied Mathematics) or 194 (Undergraduate Thesis) or 180 (Special Topics) or an approved substitute in consultation with the Undergraduate Vice Chair .......................................3-4

Total Units for the Major ................96-108

Recommended Language Preparation, Bachelor of Science degree candidates are advised, but not required, to satisfy the same language requirement as that for a Bachelor of Arts degree candidate, and to fulfill it in French, German, or Russian.
Mathematics

Major Advisers. For a current list of faculty and staff advisers, contact the Student Services office at studentservices@ucdavis.edu, or see https://www.math.ucdavis.edu/undergrad/advising/advisers/.

Depth Subject Matter Requirements. Certain mathematically oriented courses given by other departments may be counted toward the satisfaction of the depth subject matter requirements with prior departmental approval. Up to three units of Mathematics 194 may be counted toward the depth subject matter requirements. Additionally, up to three units of Mathematics 198 or Mathematics 199 can be counted.

Statement of Objectives. As early as possible, but no later than the last quarter of the sophomore year or no later than the beginning of the first quarter of the junior year for transfer students, each prospective mathematics major, in consultation with a faculty adviser, should file a formal program of study in one of the majors offered in mathematics. Information regarding the Department of Mathematics’ website,www.math.ucdavis.edu,or by sending an email to studentservices@math.ucdavis.edu.

Mathematics Placement Requirement. Students who wish to enroll in Mathematics 12, 16A, 17A, 21A, 21AH, and 36 must satisfy the mathematics placement requirement by taking an online exam. Students who do not satisfy the requirement will be administratively dropped from these courses. For more information, including preparation tips and how to access the online exam, please see the Department’s website, at http://www.math.ucdavis.edu/undergrad/math_placement, well in advance of enrolling.

Department Honors. Students who have completed at least 135 units with a minimum GPA of 3.500 in courses counted towards their major will be considered for Department Honors.

Students who meet the minimum GPA requirement for honors at graduation for the College of Letters and Science and who complete a senior project as part of Math 194 or 199 units in consultation with their faculty adviser may also be recommended by the department for graduation with High Honors or Highest Honors. Recommendations will be based on evaluations of academic achievements in their major and the quality of their senior project. For complete details, see our website at http://www.math.ucdavis.edu.

Minor Program Requirements:

Mathematics ............................ 20

Upper division units in mathematics, exclusive of Mathematics 192, 197CC, 198, 199, are counted toward the minor. ............................ 20

Teaching Credential Subject Representative. Ali Dad-del

Graduate Study. The Department offers programs of study and research leading to the M.A. and Ph.D. degrees in Mathematics. Information regarding graduate study may be obtained by consulting our website, and by sending an email to studentservices@math.ucdavis.edu.

Courses in Mathematics (MAT)

Lower Division

B. Elementary Algebra (no credit)

Lecture—3 hours. Not open to Concurrent student enrollment. Basic concepts of algebra, including polynomials, factoring, equations, graphs, and inequalities. Only if sufficient number of students enroll. (P/NP grading only)—F, F

C. Trigonometry (no credit)

Lecture—2 hours. Not open to Concurrent student enrollment. Basic concepts of trigonometry, including trigonometric functions, identities, inverse functions, and applications. Offered only if sufficient number of students enroll. (P/NP grading only)—F, F

D. Intermediate Algebra (no credit)

Lecture—3 hours. Not open to Concurrent student enrollment. Basic concepts of algebra, including planetary, logarithms, and exponential functions, prepare student for college work in mathematics, such as course 16A or 21A. Functions, equations, graphs, logarithms, and systems of equations. Offered only if sufficient number of students enroll. (P/NP grading only)—F, F, W, W

12A. Precalculus (3)

Lecture—3 hours. Prerequisite: two years of high school algebra, plane geometry, plane trigonometry, and obtaining required score on the Precalculus Diagnostic Examination. Topics selected for their use in calculus, including functions and their graphs, slope, zeroes of polynomials, exponential, logarithmic and trigonometric functions, sketching surfaces and solids. Not open for credit to students who have completed any courses 16A, 16B, 16C, 17A, 17B, 17C; only 2 units of credit to students who have completed course 16A. GE credit: SciEng|QL, SE, SL—F, W, W, F, W, S

Note: Mathematics 16A, 16B, and 16C are intended for students who will take no more Mathematics courses. Mathematics 17A, 17B, and 17C have the same level of rigor as 16A, 16B, and 16C, yet are much more broadly based (containing algebra, differential equations and probability, besides traditional calculus), and are intended for biology.

16A. Short Calculus (3)

Lecture—3 hours. Prerequisite: course 16A, 17A, or 21A. Integration; calculus for trigonometric, exponential, and logarithmic functions; applications. Not open for credit to students who have completed courses 17A, 17B, or 21C. Only 2 units of credit to students who have completed course 17A. GE credit: SciEng|QL, SE, SL—F, W, S, F, W, S

16B. Short Calculus (3)

Lecture—3 hours. Prerequisite: course 16A, 17A, or 21A. Integration; calculus for trigonometric, exponential, and logarithmic functions; applications. Not open for credit to students who have completed courses 17A, 17B, or 21C. Only 2 units of credit to students who have completed course 17A. GE credit: SciEng|QL, SE, SL—F, W, S, F, W, S

16C. Short Calculus (3)

Lecture—3 hours. Prerequisite: course 16B, 17B, or 21B. Differential equations; partial derivatives; double integrals; applications; series. Not open for credit to students who have completed course 21C. Only 2 units of credit to students who have completed course 17C. GE credit: SciEng|QL, SE, SL—F, W, S, F, W, S

Note: Mathematics 16A, 16B, and 16C are intended for students who will take no more Mathematics courses. Mathematics 17A, 17B, and 17C have the same level of rigor as 16A, 16B, and 16C, yet are much more broadly mathematically (containing algebra, differential equations and probability, besides traditional calculus), and are intended for biology students.

17A. Calculus for Biology and Medicine (4)

Lecture—3 hours; discussion—1 hour. Prerequisite: two years of high school algebra, plane geometry, plane trigonometry, and analytic geometry, and satisfying the Mathematics Placement Requirement. Introduction to differential calculus via applications in biology and medicine. Fundamental theory of calculus, techniques of integration including integral tables and numerical methods, improper integrals, elementary first order differential equations, applications in biology and medicine. Not open for credit to students who have completed course 16C, 21B, or 21C. Only 2 units of credit for students who have completed course 16B. GE credit: SciEng|QL, SE, SL—F, W, S, F, W, S

17B. Calculus for Biology and Medicine (4)

Lecture—3 hours; discussion—1 hour. Prerequisite: course 16A, 17A, or 21A. Introduction to integral calculus and elementary differential equations via applications to biology and medicine. Fundamental theorem of calculus, techniques of integration including integral tables and numerical methods, improper integrals, elementary first order differential equations, applications in biology and medicine. Not open for credit to students who have completed course 16C, 21B, or 21C. Only 2 units of credit for students who have completed course 16B. GE credit: SciEng|QL, SE, SL—F, W, S, F, W, S

17C. Calculus for Biology and Medicine (4)

Lecture—3 hours; discussion—1 hour. Prerequisite: course 17B with C- or above. Matrix algebra, functions of several variables, partial derivatives, systems of linear differential equations, and applications in biology and medicine. Not open for credit to students who have completed course 21C; only 2 units of credit to students who have completed course 16C, GE credit: SciEng|QL, SE, SL—F, W, S, F, W, S

21A. Calculus (4)

Lecture—3 hours; discussion—1 hour. Prerequisite: two years of high school algebra, plane geometry, plane trigonometry, and analytic geometry, and satisfying the Mathematics Placement Requirement. Functions, limits, continuity. Slope and derivative. Differentiation of algebraic and transcendental functions. Applications to motion, natural growth, graphing, elementary functions and the central limit theorem. Not open for credit to students who have completed course 16B, 16C, 17B, or 17C. Only 2 units of credit to students who have completed course 16A or 17A. GE credit: SciEng|QL, SE, SL—F, W, S, F, W, S

21AH. Honors Calculus (4)

Lecture/discussion—4 hours. Prerequisite: a Precalculus Diagnostic Examination score significantly higher than the minimum for course 21A is required. More intensive treatment of material covered in course 21A. Offered irregularly. GE credit: SciEng|QL, SE.

21AL. Emerging Scholars Program Calculus Workshop (2)

Workshop—6 hours. Prerequisite: concurrent enrollment in course 21A. Functions, limits, continuity. Slope and derivative. Same course content as course 21A. Enrollment for students in the Emerging Scholars Program by instructor’s invitation only. (P/NP grading only.) Offered irregularly. GE credit: SE.

21B. Calculus (4)

Lecture—3 hours; discussion—1 hour. Prerequisite: course 21A or 21AH. Continuation of course 21A. Definition of definite integral, fundamental theorem of calculus, techniques of integration. Application to area, volume, arc length, average of a function, improper integral, surface of revolution. Only 2 units of credit to students who have completed course 16C, 16C, 17B, or 17C. GE credit: SciEng|QL, SE, SL—F, W, S, F, W, S

21BH. Honors Calculus (4)

Lecture/discussion—4 hours. Prerequisite: a grade of B or better in course 21A or 21AH. More intensive treatment of material covered in course 21B. Students completing 21BH can continue with course 21CH or the regular 21C. Offered irregularly. GE credit: SciEng|SE.

21BL. Emerging Scholars Program Calculus Workshop (2)

Workshop—6 hours. Prerequisite: course 21A or 21AH; concurrent enrollment in course 21A. Same course content as 21B. Enrollment for students in the Emerging Scholars Program by instructor’s invitation only. Offered irregularly. (P/NP grading only.) GE credit: SE.
128A. Numerical Analysis (4)
Lecture—3 hours; project. Prerequisite: course 21C; Computer Science Engineering 30. Error analysis, approximation, interpolation, numerical differentiation and integration. Programming in language such as Pascal, Fortran, or BASIC required. GE credit: SciEng | QL, SE.—W, (F).

128B. Numerical Analysis in Solution of Equations (4)
Lecture—3 hours; project. Prerequisite: course 21C; 22A or 22B; and Computer Science Engineering 30. Solution of nonlinear equations and nonlinear systems. Iterative solutions of systems of simultaneous equations. Simultaneous linear equations. Eigenvalue problems. Programming in language such as Pascal, Fortran, or BASIC required. GE credit: SciEng | QL, SE.—W, (F).

128C. Numerical Analysis in Differential Equations (4)
Lecture—3 hours; project. Prerequisite: course 22A or 67, 22B; and Computer Science Engineering 30. Difference equations, operators, numerical differentiation and integration. Programming in language such as Pascal, Fortran, or BASIC required. GE credit: SciEng | QL, SE.—W, (F).

146. Algebraic Combinatorics (4)
Lecture/discussion—4 hours. Prerequisite: courses 25, 22A or 67, 145. Enumeration, Polya theory, generating functions, symmetric functions, and complex combinatorics. Not open for credit to students who have completed former course 149A. GE credit: SciEng | SE.—F, (F). (F).

147. Topology (4)
Lecture—3 hours; extensive problem solving. Prerequisite: course 25. Basic notions of point-set and combinatorial topology. GE credit: SciEng | SE.—F, (F).

148. Discrete Mathematics (4)
Lecture/discussion—4 hours. Prerequisite: course 25 or 22A and 108. Logic, error-correcting codes, finite fields and the algebraic concepts needed in their development. Not open for credit to students who have completed former course 149B. GE credit: SciEng | QL, SE.—W, (F).

150A. Modern Algebra (4)
Lecture/discussion—4 hours. Prerequisite: course 67, 22A or 108. Basic concepts of groups, symmetries of the plane. Emphasis on the techniques used in the proof of the ideas [Lemmas, Theorems, etc.] developing these concepts. Precise thinking, proof writing, and the ability to deal with abstraction. GE credit: SciEng | SE.—F, (F). (F).

150B. Modern Algebra (4)
Lecture—discuss—4 hours. Prerequisite: course 150A. Bilinear forms, rings, factorization, modules. GE credit: SciEng | QL, SE.—W, (F).

150C. Modern Algebra (4)
Lecture—discuss—4 hours. Prerequisite: course 150B. Group representations, fields, Galois theory. GE credit: SciEng | SE.—S, (S).

160. Mathematical Foundations of Database Theory, Design and Performance (4)
Lecture—3 hours; project. Prerequisite: course 22A or 67; one of the following courses: 25, 108, 114, 115A, 141, or 145. Relational model; relational algebra, relational calculus, normalization, functional and multivalued dependencies. Separability, Cost benefit analysis of physical database design and reorganization. Performance via analytical modeling, simulation, and queueing theory. Block accesses; buffering; operating system contention; CPU intensive operations. Offered irregularly. GE credit: SciEng | QL, SE.—W, (F).

163. Mathematics and Computers (4)
Lecture—3 hours; project. Prerequisite: course 22A or 67, and one of the following courses: 25, 108, 114, 115A, or 145. Introduction to computational mathematics, symbolic computation, and computer generated/verified proofs in algebra, analysis and geometry. Examination of new viewpoints developed in conjunction with modern computational questions and the role that computers play in mathematical conjecture and experimentation. GE credit: SciEng | QL, SE.—W, (F).

167. Applied Linear Algebra (4)
Lecture—3 hours; extensive problem solving. Prerequisite: course 22A or 67. Applications of linear algebra: LU and QR matrix factorizations, eigenvalue and singular value decompositions. GE credit: SciEng | QL, SE.—S, (S).

168. Optimization (4)

180. Special Topics (3)
Lecture—3 hours. Prerequisite: course 67 or both 22A and 108; and 25. Special topics from various fields of modern, pure, and applied mathematics. May be repeated to a maximum of 12 units. May be repeated for credit when topic differs. Offered irregularly. GE credit: SciEng | SE.—W, (F).

185A. Complex Analysis (4)
Lecture—3 hours; extensive problem solving. Prerequisite: course 67 or both 22A and 108, and 125A. Complex function theory. Analyticity, Cauchy-Riemann equations, elementary functions, complex integration, power and Laurent series expansions, residue theory. GE credit: SciEng | SE.—W, (W).

185B. Complex Analysis (4)
Lecture—3 hours; extensive problem solving. Prerequisite: course 185A. Analytical functions, elementary functions and their mapping properties, applications of analyticity, integral theorem, conformal mapping, and applications to heat flow and fluid mechanics. Offered in alternate years. GE credit: SciEng | SE.—S.

189. Advanced Problem Solving (3)
Lecture—3 hours; project. Prerequisite: course 67 or both 22A and 108; and 25. Solution and presentation of advanced problem solving techniques. Solve and present interesting and challenging problems of all areas of mathematics. GE credit: SciEng | Writ OL, QL, QL, SE, WE.—S, (S).

192. Internship in Applied Mathematics (1-3)
Internship. Prerequisite: consent of instructor. Supervised work experience in applied mathematics. Final report. May be repeated for credit for a total of 10 units. (P/NP grading only) —F, W, S, (F, W, S).

194. Undergraduate Thesis (3)
Independent study. Prerequisite: consent of instructor. Independent research under supervision of a faculty member. Student will submit written report in thesis form. May be repeated with consent of Vice Chairperson. (P/NP grading only) —F, W, S, (F, W, S).

197TC. Tutoring Mathematics in the Community (1-5)
Seminar—1-2 hours; laboratory—2-6 hours. Prerequisite: consent of instructor. Special projects in mathematical education development. Tutoring in mathematics instruction and tutoring on an individual or small group basis. May be repeated one time for credit. (P/NP grading only) —F, W, S, (F, W, S).

198. Directed Group Study (1-5)
Prerequisite: consent of instructor. (P/NP grading only) —F, W, S, (F, W, S).

199. Special Study for Advanced Undergraduates (1-5)
(P/NP grading only) GE credit: SE.—F, W, S, (F, W, S).

Credited to:

200A. Problem-Solving in Analysis (1)
Lecture—1 hour; extensive problem solving. Prerequisite: courses 201ABC. Problem-solving in graduate analysis: continuous functions, metric spaces, Banach and Hilbert spaces, bounded linear operators, the spectral theorem, distributions, Fourier series and transforms, Lp spaces, Sobolev spaces. May be repeated twice for credit. (Deferred grading only, pending completion of sequence.)—S, (S).

200B. Problem-Solving in Analysis (1)
Lecture—1 hour; extensive problem solving. Prerequisite: courses 201ABC. Problem-solving in graduate analysis: continuous functions, metric spaces, Banach and Hilbert spaces, bounded linear operators, the spectral theorem, distributions, Fourier series and transforms, Lp spaces, Sobolev spaces. May be repeated twice for credit. (Deferred grading only, pending completion of sequence.)—F, (F).

201A. Analysis (4)

Fall 2011 and on Revised General Education (GE) ART: =Arts and Humanities; SE =Science and Engineering; SS =Social Sciences; AGCH—American Cultures; DD—Domestic Diversity; DL=Quantitative; SL=Scientific; VL=Visual; WC=World Cultures; WE=Writting Experience
Pre-Fall 2011 General Education (GE) ART—Arts and Humanities; SciEng—Science and Engineering; SocSci—Social Sciences; DivDom—Domestic Diversity; Writ=Writting Experience
Quarter Offered: F=Fall, W=Winter, S=Spring, Su=Summer; 2017/2018 offering in parentheses

Mathematics 425
201B. Analysis (4)  

201C. Analysis (4)  

202. Functional Analysis (4)  

205. Complex Analysis (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: course 185 or the equivalent, or consent of instructor. Analytic continuation, Riemann surfaces, conformal mappings, Riemann mapping theorem, entire functions, special functions, elliptic functions. —W. (W.)

205A. Complex Analysis (4)  
Lecture—3 hours; term paper or discussion—1 hour. Cauchy’s theorem, Cauchy’s integral formulas, meromorphic functions, complex logarithm, entire functions, Weierstrass infinite product formula, the gamma and zeta functions, and prime number theorems. —W. (W.)

205B. Complex Analysis (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: course 205A or consent of instructor. Conformal mappings, the Schwarz lemma, analytic automorphisms, the Riemann mapping theorem, elliptic functions, Eisenstein series, the Jacobi theta functions, asymptotic, Bessel functions, the Airy function, transformations of special functions and Riemann surfaces. May be repeated two times for credit if topic varies—S. (S.)

206. Measure Theory (4)  
Lecture—3 hours; extensive problem solving. Prerequisite: course 185 or the equivalent, or consent of instructor. Analytic continuation, Riemann surfaces, conformal mappings, Riemann mapping theorem, entire functions, special functions, elliptic functions. —W. (W.)

207A. Methods of Applied Mathematics (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: graduate standing or consent of instructor. Ordinary differential equations and dynamical systems. Variational principles. Eigenfunctions, integral equations and Green’s functions. Complex analysis and contour integration. Laplace’s equation. Diffusion equations. Wave phenomena. Dimensional analysis and scaling. Asymptotic expansions and perturbation theory. Stochastic processes and Brownian motion.—F. (F.)

207B. Methods of Applied Mathematics (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: graduate standing or consent of instructor. Ordinary differential equations and dynamical systems. Variational principles. Eigenfunctions, integral equations and Green’s functions. Complex analysis and contour integration. Laplace’s equation. Diffusion equations. Wave phenomena. Dimensional analysis and scaling. Asymptotic expansions and perturbation theory. Stochastic processes and Brownian motion.—W. (W.)

207C. Methods of Applied Mathematics (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: graduate standing or consent of instructor. Ordinary differential equations and dynamical systems. Variational principles. Eigenfunctions, integral equations and Green’s functions. Complex analysis and contour integration. Laplace’s equation. Diffusion equations. Wave phenomena. Dimensional analysis and scaling. Asymptotic expansions and perturbation theory. Stochastic processes and Brownian motion.—F. (F.)

207D. Methods of Applied Mathematics (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: course 118B or consent of instructor. Kinematics and dynamics of fluids. The Euler and Navier-Stokes equations. Vorticity dynamics. Irrotational flow. Low Reynolds number flows and the Stokes equations. High Reynolds number flows and boundary layers. Compressible fluids. Shock waves. Offered in alternate years. —F. (F.)

211A. Topology (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: graduate standing or consent of instructor. Fundamental group and covering space theory. Homology and cohomology. Manifolds and duality. CW complexes. Fixed point theorems. Offered in alternate years.—F.

215A. Topology (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: graduate standing or consent of instructor. Fundamental group and covering space theory. Homology and cohomology. Manifolds and duality. CW complexes. Fixed point theorems. Offered in alternate years.—S. (S.)

215B. Topology (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: graduate standing or consent of instructor. Fundamental group and covering space theory. Homology and cohomology. Manifolds and duality. CW complexes. Fixed point theorems. Offered in alternate years.—W. (W.)

215C. Topology (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: graduate standing or consent of instructor. Fundamental group and covering space theory. Homology and cohomology. Manifolds and duality. CW complexes. Fixed point theorems. Offered in alternate years.—S. (S.)

216. Geometric Topology (4)  
Lecture—3 hours; extensive problem solving—1 hour. Prerequisite: course 215A. Introduction to measure theory, topology, three-dimensional manifolds. Surfaces and their diﬀeomorphisms. Dehn twists. Heegaard surfaces. Theory of 3-dimensional manifolds. Knots and knot theory. Hyperbolic manifolds and geometric structures. May be repeated one time for credit. Offered in alternate years.—S. (S.)

218A. Partial Differential Equations (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: course 201ABC or consent of instructor. A year-long sequence on PDEs which covers linear transport, Laplace, heat, and wave equations, maximum principles, method of characteristics, Sobolev and Holder space theory, weak derivatives, semilinear, quasilinear, and fully nonlinear elliptic/parabolic equations, nonlinear hyperbolic equations, and compensated compactness. Offered in alternate years.—W. (W.)

218B. Partial Differential Equations (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: course 218A or consent of instructor. A year-long sequence on PDEs which covers linear transport, Laplace, heat, and wave equations, maximum principles, method of characteristics, Sobolev and Holder space theory, weak derivatives, semilinear, quasilinear, and fully nonlinear elliptic/parabolic equations, nonlinear hyperbolic equations, and compensated compactness. Offered in alternate years.—W. (W.)

218C. Partial Differential Equations (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: course 218B or consent of instructor. A year-long sequence on PDEs which covers linear transport, Laplace, heat, and wave equations, maximum principles, method of characteristics, Sobolev and Holder space theory, weak derivatives, semilinear, quasilinear, and fully nonlinear elliptic/parabolic equations, nonlinear hyperbolic equations, and compensated compactness. Offered in alternate years.—W. (W.)

221A. Mathematical Fluid Dynamics (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: course 118B or consent of instructor. Kinematics and dynamics of fluids. The Euler and Navier-Stokes equations. Vorticity dynamics. Irrotational flow. Low Reynolds number flows and the Stokes equations. High Reynolds number flows and boundary layers. Compressible fluids. Shock waves. Offered in alternate years. —F. (F.)

221B. Mathematical Fluid Dynamics (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: course 118B or consent of instructor. Kinematics and dynamics of fluids. The Euler and Navier-Stokes equations. Vorticity dynamics. Irrotational flow. Low Reynolds number flows and the Stokes equations. High Reynolds number flows and boundary layers. Compressible fluids. Shock waves. Offered irregularly.—W. (W.)

226A. Numerical Methods: Fundamentals (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: course 128AB or equivalent, or consent of instructor; familiarity with some programming language. Fundamental principles and methods in numerical analysis, including the stability of algorithms and conditioning of numerical problems, numerical methods for interpolation and integration, eigenvalue problems, singular value decomposition and its applications. Offered in alternate years.—F. (F.)

226B. Numerical Methods: Large-Scale Matrix Computations (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: course 128B or equivalent, or consent of instructor; familiarity with some programming language. Numerical methods for large-scale matrix computations, including direct and iterative methods for the solution of linear systems and the computation of eigenvalues and singular values, the solution of least-squares problems, matrix compression, methods for the solution of linear programs. Offered in alternate years.—W. (W.)

226C. Numerical Methods: Ordinary Differential Equations (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: course 226B or equivalent, or consent of instructor; familiarity with some programming language. Numerical methods for ordinary differential equations, including methods for initial-value problems and two-point boundary-value problems, theory of and methods for differential algebraic equations, dimensionality-reduced large-scale dynamical systems. Offered in alternate years.—S. (S.)

227. Mathematical Biology (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: courses 125B and 135A or Statistics 131A or consent of instructor. Mathematical models of biological systems. Applications to nerve impulse, chemotaxis, muscle contraction, and morphogenesis. Offered in alternate years.—F.

228A. Numerical Solution of Differential Equations (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: course 128C. Numerical solutions of initial-value, eigenvalue and boundary-value problems for ordinary differential equations. Numerical solutions of partial and hyperbolic partial differential equations. Offered in alternate years.—F.

228B. Numerical Solution of Differential Equations (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: course 128C. Numerical solutions of initial-value, eigenvalue and boundary-value problems for ordinary differential equations. Numerical solution of parabolic and hyperbolic partial differential equations. Offered in alternate years.—W. (W.)

228C. Numerical Solution of Differential Equations (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: course 128C. Numerical solutions of initial-value, eigenvalue and boundary-value problems for ordinary differential equations. Numerical solution of parabolic and hyperbolic partial differential equations. Offered in alternate years.—S. (S.)

225A. Probability Theory (4)  
Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: courses 125B and 135A or Statistics 131A or consent of instructor. Measure-theoretic foundations, abstract integration, independence,
246. Algebraic Combinatorics (4)

Lecture—3 hours; extensive problem solving. Prerequisite: course 245 or consent of instructor. Algebraic and geometric aspects of combinatorics. The use of structures such as groups, polytopes, rings, and simplicial complexes to solve combinatorial problems. Offered in alternate years.—(F.)

248A. Algebraic Geometry (4)


248B. Algebraic Geometry (4)

Lecture—3 hours; extensive problem solving. Prerequisite: course 248A. Complex varieties and the analytic topology. Sheaves and schemes. Fiber products. Separatedness and properness. Applications of scheme theory. Offered in alternate years.—(W.)

249A. Problem-Solving in Algebra (1)

Lecture—1 hour; extensive problem solving. Prerequisite: courses 250A & B. Problem-solving in graduate algebra: groups, rings, modules, matrices, tensor products, representations, Galois theory, ring extensions, commutative algebra and homological algebra. May be repeated for credit. (Deferred grading only, pending completion of sequence).—(S.)

249B. Problem-Solving in Algebra (2)

Lecture—2 hours; extensive problem solving. Prerequisite: courses 250A & B. Problem-solving in graduate algebra: groups, rings, modules, matrices, tensor products, representations, Galois theory, ring extensions, commutative algebra and homological algebra. May be repeated for credit. (Deferred grading only, pending completion of sequence).—(F.)

250A. Algebra (4)

Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: courses 201C or 239; 250ABC recommended. Algebraic structures, Brownian motion, stochastic integration, stochastic differential equations. Diffusions, connections with partial differential equations, mathematical finance. Offered in alternate years.—(F.)

250B. Algebra (4)

Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: courses 201C or 239; 250ABC recommended. Algebraic structures, Brownian motion, stochastic integration, stochastic differential equations. Diffusions, connections with partial differential equations, mathematical finance. Offered in alternate years.—(W.)

250C. Algebra (4)

Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: graduate standing in mathematics or consent of instructor. Group and rings. Sylow theorems, abelian groups, Jordan-Holder theorem. Rings, unique factorization. Algebras, and modules. Fields and vector spaces over arbitrary fields. Commutative rings. Representation theory and its applications.—(F.)

250D. Algebra (4)

Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: graduate standing in mathematics or consent of instructor. Group and rings. Sylow theorems, abelian groups, Jordan-Holder theorem. Rings, unique factorization. Algebras, and modules. Fields and vector spaces over arbitrary fields. Commutative rings. Representation theory and its applications.—(W.)

258A. Numerical Optimization (4)

Lecture—3 hours; term paper or discussion—1 hour. Prerequisites: courses 215, 239, and 250ABC. Numerical methods for infinite dimensional optimization problems. Newton and quasi-Newton methods, linear and sequential quadratic programming, barrier methods, large-scale optimization, theory of approximations, infinite and semi-infinite programming; applications to optimal control, stochastic optimization and distributed systems. Offered in alternate years.—(F.)

258B. Discrete and Mixed-Integer Optimization (4)

Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: courses 25 and 167, or consent of the instructor. Combinatorial, integer, and mixed-integer linear optimization problems. Ideal and strong formulations, cutting planes, branch and cut, decomposition methods. Offered in alternate years.—(W.)

261A. Lie Groups and Their Representations (4)


261B. Lie Groups and Their Representations (4)


265. Mathematical Quantum Mechanics (4)

Lecture—3 hours; term paper or discussion—1 hour. Prerequisite: course 265 or consent of instructor. Mathematical principles of statistical mechanics and quantum field theory. Topics include classical and quantum lattice systems, variational principles, spontaneous symmetry breaking and phase transitions, second quantization and Fock space, and fundamentals of quantum field theory. May be repeated one time for credit. Offered in alternate years.—(W.)

271. Applied and Computational Harmonic Analysis (4)

Lecture—3 hours; extensive problem solving. Prerequisite: courses 125B or 201C, and 128B or 167, and 129 or equivalent, or consent of instructor. Introduction to mathematical basic building blocks (wavelets, local Fourier basis, etc.) useful for diverse fields (signal and image processing, numerical analysis, and statistics). Emphasis on the connections between the continuum and the discrete worlds. Offered in alternate years.—(W.)

280. Topics in Pure and Applied Mathematics (3)

Lecture—3 hours; prerequisite: graduate standing. Special topics in various fields of pure and applied mathematics. Topics to be chosen based on the research interests of students and faculty. May be repeated for credit when topic differs.—F. W. S. (F. W. S.)
Medical Informatics (A Graduate Group)

See Health Informatics (A Graduate Group), on page 359.

Medical Microbiology

See Medicine, School of, on page 427.

Medical Pharmacology and Toxicology

See Medicine, School of, on page 427.

Medicine

See Medicine, School of, on page 427; and Medicine and Epidemiology (VME), on page 582.

Medical, School of

Julie Ann Freischlag, M.D.

428 Medical Informatics (A Graduate Group)

Darin Latimore, M.D.

Associate Dean for Student and Resident Diversity

James Nuovo, M.D.

Associate Dean for Graduate Medical Education

Mark Servis, M.D.

Senior Associate Dean for Curriculum and Competency Development

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http://www.ucdmc.ucdavis.edu/medschool/

Faculty

To search for current faculty, see http://www.ucdmc.ucdavis.edu/search/faculty/searchdetail.aspx?searchtype=3

Admission Requirements and Professional Curriculum

Detailed information can be obtained from the School of Medicine; see School of Medicine, on page 137.

Courses in the School of Medicine

Curriculum for the School of Medicine

The curriculum for the M.D. degree at the UC Davis School of Medicine is a four-year program providing comprehensive preparation for graduate medical training (interships and residencies) and the practice of medicine. It offers a blend of basic science training and clinical experience with opportunities for research.

The first-year curriculum begins in August and extends into May and is organized into two blocks, Foundations and Mechanisms & Diseases. The basic science portion of the Foundations block includes courses in Molecular Biology, Cell and Tissue Biology, Gross Anatomy/Embryology/Radiology, and Human Physiology. The major organizing theme is structure-function along the continuum of hierarchical biological structure from molecule to cell, tissue and major organ systems. The three year Doctoring curriculum begins with Doctoring 1, which is presented concurrently with the other courses. The focus of Doctoring 1 is physical examination training using standardized patients and models, correlated with concurrent gross anatomy and physiology by organ system. Behavioral medicine, epidemiology, biostatistics, cross-cultural medicine, and ethics are woven into the cases and didactic presentations and team-based learning modules. Students are required to attend preceptorships in the community and participate in home visits. Periodic quizzes and review sessions are used in the basic science courses throughout the block for formative assessment, and all courses administer comprehensive summative final examinations in December.

The Mechanisms & Disease block of the first-year curriculum begins in January and extends through April, with final exams in early May. There are two major threads, each of which is composed of several integrated courses. The Doctoring 1 course is offered concurrently. The Immunology/Microbiology/Pharmacology/Pathology thread presents an introduction to host defense, infection, basic pharmacologic principles, and general pathologic processes. The Endocrinology/Nutrition/Reproduction/Genetics (ENRG) thread covers essential concepts in genetics, basic and clinical nutrition, reproductive medicine, and clinical endocrinology. The general pathology course also includes male-female GU and endocrine pathology, and the pharmacology course covers antibiotics and endocrine pharmacology, with the goal of integration with concurrent courses. Periodic quizzes and review sessions provide formative feedback, and final examinations are used for summative assessment. The Doctoring 1 course continues with an emphasis on interviewing skills and clinical assessment. Cases are used in the problem-based learning approach for basic-science-clinical correlation, and for the exploration of psychosocial issues.