Program Description
Mathematics is a unique and valuable science that can be exciting, enjoyable, and rewarding. The Department of Mathematics provides a collection of mathematics courses designed to challenge and stimulate all openminded and thoughtful students regardless of individual backgrounds or major interest areas. This is done by combining flexibility, applicability, and historical perspective in the design of the mathematics curriculum. Furthermore, depth of understanding and appreciation are not sacrificed to quantity; the major emphasis is upon inquiry, creativity, methods, techniques, and thought processes rather than bulk of material.

The classroom goal is to discover both the importance and beauty of mathematics by combining lectures with discussions, problem solving laboratories, student presentations, writing assignments, computer experience, and any other workable approaches to learning. As such, the CSUB mathematics department is one of few institutions nationwide which includes a 145 minute laboratory session in every 5 unit mathematics course. A student is encouraged to interpret and communicate mathematically with others, to follow selfdirection and indepth study, and to investigate interrelatedness of mathematical concepts. A teacher acts as a resource person, stresses the spirit and point of view of mathematics, and provides for feedback of the relative value of classroom activities.

Upon completion of any mathematics course, students are better equipped to be participants in a highly technological, scientifically complex environment. From a subjective point of view, they should have an improved grasp of the art and beauty of rational reasoning and discourse both as an observer and a participant. From an objective point of view, they should have acquired new skills which, alone or in combination with others, will enhance both an understanding of and performance in the scientific world. A detailed description of student learning goals and objectives can be found at http://www.csub.edu/math/files/Math%20SLOs.pdf

With the completion of a mathematics major, a student, depending upon the choice of upper division courses, may pursue: (1) a career or advanced studies in the mathematical sciences (Applied Track or Statistics Track); (2) a career in teaching (Teaching Tracks, with or without a California Teaching Credential); or (3) a course of graduate study leading to an advanced degree in pure mathematics (Theoretical Track). The Applied Track includes courses in differential equations, numerical analysis, complex analysis, and partial differential equations. The Statistics Track includes courses in nonparametric statistics, design of experiments, analysis of variance and regression analysis. The Teaching Track includes courses in geometry, number theory, and probability and statistics. The Theoretical Track includes abstract algebra, real and complex analysis, probability, and number theory.

In all tracks, students gain experiences through student presentations and discussion in laboratory periods.

Requirements for the Bachelor of Science Degree with a Major in Mathematics
The Bachelor of Science Degree with a major in Mathematics requires a minimum of 180 units which includes courses for the major (and minor, if selected) and courses for the other university-wide graduation requirements: General Education, American Institutions, First-Year Experience, Gender-Race-Ethnicity, Upper Division Writing, and Foreign Language (see pages 59-63).
Students seeking a major in Mathematics must complete the following:

1. MATH 201, 202, 203, 222, 300, 330, 340, 363
2. CMPS 221
3. One of the following tracks:
   a. Applied Mathematics Track
      (1) MATH 204, 205, 331, 490
      (2) Two of MATH 305, 312, 350, or 402
      (3) One course from the following list: BIOL 201, 310; CHEM 211, 212; CMPS 222, 223; ECON 201, 202, 301, 302; MGMT 301, PHYS 221, 222. If one of these courses will be used to satisfy a General Education requirement, a different course must be taken to satisfy the Applied Mathematics Track requirement.
      (4) Two additional upper division MATH electives
   b. Statistics Track
      (1) MATH 204, 215, 331, 440, 490
      (2) MATH 338 or 339
      (3) An upper division cognate course to be approved by the Mathematics Department.
      (4) Two additional upper division MATH electives.
   c. Teaching Track (does not include the required credential courses)
      (1) MATH 301, 301B, 360, 440, 450, 491
      (2) One of MATH 204 or 205
      (3) EDSE 400
      (4) Two additional upper division MATH electives
   d. Theoretical Mathematics Track
      (1) MATH 204, 312, 331, 430, 490
      (2) One of MATH 431 or 463
      (3) Three additional upper division MATH electives

Requirements for the Teaching-Track Major in Mathematics Including a California Teaching Credential: Blended Program in Mathematics

The Mathematics Department offers a program which blends the single subject requirements in the mathematics teaching-track with the pedagogy courses in CSUB’s School of Education Single Subject Credential Program, yielding an integrated program of study over four years and including 196 units. Students graduate with both a BS in Mathematics and a Level 1 (Preliminary) Single Subject Credential in mathematics. Students in the program will have an advisor in the Mathematics Department and an advisor in the School of Education.

The Bachelor of Science Degree with a teaching-track major in Mathematics component of this blended program includes courses for the major and courses for the other university-wide graduation requirements: General Education, American Institutions, First-Year Experience, Gender-Race-Ethnicity, Upper Division Writing, and Foreign Language (see pages 59-63).

Students seeking the blended program in Mathematics must complete the following:

1. MATH 201, 202, 203, 222, 300, 301, 301B, 330, 340, 360, 363, 440, 450, 491.
2. CMPS 221.
3. One of MATH 204 or 205.
4. One additional upper division MATH elective
5. EDBI 475, 476
6. EDSP 301; EDSE 401, 403, 405, 406, 407, 408, 499 (9 units); and 5 assorted TPA units.

Notes:

1 At most two of MATH 301, 331 and 430 can count towards the major; MATH 320 and 321 do not count toward the major.
2 MATH 331 and 430 together may substitute for MATH 301 and an upper division MATH elective.
3 Cannot be substituted by Math 301.

Honors Option
A student may, with the approval of the Chair of the Department of Mathematics, undertake the Honors Program in Mathematics by completing the following:

1. One of the tracks A, B, C or D.
2. An additional ten hours of upper division courses in mathematics (not to include MATH 320 or 321).
3. Included in 1 and 2 above, at least one of these upper division sequences in Mathematics: MATH 331-431 Algebraic Structures I and II, MATH 363-463 Real Analysis I and II, MATH 205-402 Ordinary and Partial Differential Equations, MATH 360-420 Geometry, and MATH 340-440 Probability and Statistics.
4. MATH 492 Senior Honors Thesis and presentation of an Honors thesis to the Department of Mathematics.

Requirements for the Minor in Applied Statistics
Although no minor is required for the BS degree in Mathematics, a minor in Applied Statistics is available, consisting of 20 quarter units chosen from MATH 140 (or equivalent), 215, 338, 339, 340, and 440.

Requirements for Minor in Mathematics
Although no minor is required for the BS degree in Mathematics, a minor in Mathematics is available. The requirement is 20 units, at least 10 of which must be upper division. Lower division courses that can count are MATH 202, 203, 204, and 205. Upper division courses that do not count are MATH 320 and 321.

COURSE DESCRIPTIONS

Developmental Mathematics

Note: MATH 75 and MATH 85 may be taken as a course using the interactive online educational system ALEKS. This course requires students to work online using ALEKS a minimum of 12 hours per week, some of which will occur in class. GST 75 is a corequisite for MATH 75, Dev. Math I-ALEKS and GST 85 is a corequisite for MATH 85, Dev. Math II-ALEKS.

MATH 75 Developmental Mathematics I (5)
First of two courses reviewing fundamental concepts, geometry, basic data analysis, and introductory algebra. Topics include: Operations and ordering of real numbers; plotting on the number line; algebra of polynomial expressions; linear equations; linear inequalities in one variable; equations and graphs of lines; systems of linear equations; graphical representations of data; mean, median and mode; estimation and prediction; introduction to counting and probability; perimeter, area, and volume; angles in the plane; special triangles; congruence; Pythagorean Theorem; parallel and perpendicular lines. Emphasis is on applications of concepts. Course does not count toward graduation. Prerequisite: A score of 36 or below on the ELM. (4 units lecture & 1 unit lab)

MATH 85 Developmental Mathematics II (5)
Second of two courses reviewing fundamental concepts, geometry, basic data analysis, and introductory algebra. Topics include: Functions; algebra of polynomial rational and radical expressions; factoring; introduction to rational exponents; solutions of linear, absolute value, quadratic rational and radical equations; solutions of linear inequalities in two variables; graphs of quadratic functions; midpoint and distance formulas; ratio, proportion and similar triangles; square and higher-order roots. Emphasis is on applications of concepts. Course does not count toward graduation. Prerequisite: (1) A score of 38 - 48 on the ELM; or (2) a passing grade in MATH 75. (4 units lecture & 1 unit lab)

Lower Division
To enroll in any course numbered 100 or above, a student must have satisfied the Entry Level Mathematics requirement.

MATH 101 Finite Mathematics (5)
Mathematical topics for business; social, and life sciences selected from logic; set theory; combinatorics; statistics; matrix algebra; linear programming; Markov chains; analytic geometry; graph theory; and
mathematics of finance. Prerequisite: (1) MATH 85; or (2) other satisfaction of the Entry Level Mathematics requirement. (4 units lecture & 1 unit lab) **GE B4**

**MATH 120 Introduction to Quantitative Methods in Business (5)**
Matrix algebra and systems of equations, analytic geometry, basic concepts of differential calculus and introduction to integral calculus. Applications from the areas of business and economics. Course makes use of appropriate computing technology and graphing utilities. Prerequisite: (1) MATH 85; or (2) other satisfaction of the Entry Level Mathematics requirement. (4 units lecture & 1 unit lab)

**MATH 140 Elementary Statistics (5)**
Descriptions of sample data; exploratory data analysis; elementary probability; binomial, normal, t-, and other distributions; estimation and hypothesis testing techniques; linear regression and correlation; analysis of variance and chi-square tests. Use of statistical packages. Applications to fields including business, natural sciences, social sciences, and humanities. Prerequisite: (1) MATH 85; or (2) other satisfaction of the Entry Level Mathematics requirement. (Credit toward graduation cannot be earned for both MATH 140 and PSYC 200.) (4 units lecture & 1 unit lab) **GE B4**

**MATH 190 Pre-calculus I: Intermediate and College Algebra (7)**
Review of intermediate algebra including operations with polynomials and radicals, and absolute value. The algebraic and graphical analysis of polynomial, rational, exponential, and logarithmic functions and their applications. The concept of function is used as a unifying theme. This course makes use of graphing utilities. Prerequisite: (1) MATH 85; or (2) other satisfaction of the Entry Level Mathematics requirement. It is recommended that students enroll concurrently in MATH 281 (4 units lecture & 3 units lab)

*Note: Students whose previous intermediate algebra coursework is not recent are strongly encouraged to enroll in MATH 190. Students may receive credit for either MATH 190 or MATH 191, but not both.*

**MATH 191 Pre-calculus I: College Algebra (5)**
Algebraic and graphical analysis of polynomial, rational, logarithmic and exponential functions and their applications. The concept of function is used as a unifying theme. This course makes use of graphing utilities. Prerequisite: (1) Score of (a) 50 or higher on the ELM Exam, (b) 550 or higher in the SAT (Math) exam, or (c) 23 or higher in the ACT (Math) exam; or (2) Satisfaction of the Entry Level Mathematics requirement and a passing score on the Pre-calculus Readiness Test. It is recommended that students enroll concurrently in MATH 281. (4 units lecture & 1 unit lab)

**MATH 192 Pre-calculus Mathematics II: Trigonometric Functions (5)**
Algebraic, geometric and graphical analysis of trigonometric functions and their applications. Unit circle trigonometry. Trigonometric functions of real numbers. Introduction to polar coordinates and conics. This course makes use of graphing utilities. Prerequisite: A grade of C- or better in MATH 190 or 191 It is recommended that students enroll concurrently in MATH 281. (4 units lecture & 1 unit lab)

**MATH 201 Calculus I (5)**
Introduction to the differential calculus of elementary functions (including logarithmic, exponential, and trigonometric functions). Emphasis on limits, continuity, and differentiation. Applications of differentiation (including curve sketching, optimization, and related rates; antiderivatives. Students may not use any Computer Algebra System (CAS) capability in this course. Prerequisite: (1) A grade of C- or better in MATH 192; or (2) Satisfaction of the Entry Level Mathematics requirement and an appropriate score on the UC/CSU MDTP Calculus Readiness Test or equivalent. It is recommended that students enroll concurrently in MATH 281. (4 units lecture & 1 unit lab)

*Note: Students without recent credit in MATH 192 are advised to consult the Department of Mathematics and to take the UC/CSU Pre-calculus Diagnostic Test before enrolling in MATH 201.*

**MATH 202 Calculus II (5)**
Introduction to the integral calculus of elementary functions. The Fundamental Theorem of Calculus; techniques of integration; applications of integration; improper integrals; sequences and series. This
**Course may make use of computer algebra systems.** Prerequisite: A grade of C- or better in MATH 201. It is recommended that student enrolls concurrently in MATH 281. (4 units lecture & 1 unit lab)

**MATH 203 Calculus III (5)**
Three dimensional analytic geometry; parametric curves; functions of several variables; partial and directional derivatives; the chain rule; gradients; optimization, double integrals. This course may make use of computer algebra systems. Corequisite/Prerequisite: MATH 222 or CMPS 222. Prerequisite: A grade of C- or better in MATH 202 or MATH 212. Students without credit in MATH 222 or CMPS 222 are required to enroll in either concurrently. (4 units lecture & 1 unit lab)

**MATH 204 Calculus IV (5)**
Lagrange multipliers; polar, cylindrical and spherical coordinates; double integrals; triple integrals; vector calculus, including line and surface integrals, the Fundamental Theorem of Line Integrals, and the theorems of Green, Stokes, and Gauss; selected topics. This course may make use of computer algebra systems. Corequisite/Prerequisite: MATH 222 or CMPS 222. Prerequisite: A grade of C- or better in MATH 203. Students without credit in MATH 222 or CMPS 222 are required to enroll in either concurrently. (4 units lecture & 1 unit lab)

**MATH 205 Ordinary Differential Equations (5)**
First-order differential equations; linear differential equations; linear systems. Laplace transforms; and/or series solutions of second-order linear equations; geometric approach to nonlinear differential equations and to questions of stability. Corequisite/Prerequisite: MATH 222 or CMPS 222. Prerequisite: A grade of C- or better in MATH 203. (4 units lecture & 1 unit lab)

**MATH 206 Advanced Engineering Mathematics (5)**
Introduction to ordinary differential equations, Fourier Series and Integral, other transforms, and partial differential equations; applications to computer hardware such as the resonance, wave equation, transmission line equation, and filtering. Cross-listed as CMPS 206. Prerequisite: MATH 203. (4 units lecture & 1 unit lab)

**MATH 211 Calculus for Life Sciences and Medicine I (5)**
Discrete time models, sequences and difference equations with applications in the life sciences. Introduction to differential calculus with emphasis on limiting behavior. Applications include optimization and stability. Trigonometry is addressed throughout the course. This course makes use of technology, and is designed for the life sciences; it is not intended for students in the physical or mathematical sciences. Course will not serve as prerequisite for Math 202. Prerequisite: (1) A grade of C- or better in Math 190 or Math 191; or (2) Satisfaction of the Entry Level Mathematics requirement and an appropriate score on the UC/CSU MDPT Calculus Readiness Test. It is recommended that students enroll concurrently in MATH 281. (3 units lecture & 2 unit lab)

**MATH 212 Calculus for Life Sciences and Medicine II (5)**
Introduction of the integral calculus of elementary functions. Integration techniques and computational methods; differential equations; equilibria and their stability. This course makes use of technology, and is designed for the life sciences; it is not intended for students in the physical or mathematical sciences. Not open to students with credit in Math 201. Prerequisite: A grade of C- or better in Math 211. It is recommended that students enroll concurrently in MATH 281. (3 units lecture & 2 unit lab)

**MATH 215 Applied Nonparametric Statistics (5)**
Nonparametric tests including one-sample methods, two-sample methods, k-sample methods, paired comparisons and blocked designs, tests for trends and association, multivariate-test, analysis of censored data, nonparametric bootstrap methods, multi-factor experiments, smoothing methods and robust model fitting. Prerequisite: MATH 140. (4 units lecture & 1 unit lab)

**MATH 221 Introduction to Number Systems and Reasoning (5)**
Introduction to set theory, inductive and deductive reasoning including patterns and sequences. The development and structure of the real number system beginning with whole numbers, numeration
systems, computational algorithms, number theory, estimation and uses of calculators in problem solving. The use of proportional reasoning in numerical and algebraic problems. This course involves substantial use of 2- and 3- dimensional concrete materials in a cooperative learning laboratory setting. Required for entry into the CSUB Multiple Subjects Credential Program. Prerequisite: (1) MATH 85; or (2) other satisfaction of the CSU Entry Level Mathematics Requirement. (4 units lecture & 1 unit lab)

MATH 222 Laboratory Experience (3)
Introduction to the use of a computer algebra system in exploring applications in differential and integral calculus. Prerequisite: A grade of C- or better in MATH 201. (3 units lecture)

MATH 240 America Counts Tutor Training (1)
Course provides CSUB America Counts tutors with tutor training and is required for all tutors in the America Counts Program. Prerequisite: Permission of instructor. Offered on a credit, no-credit basis. (1 unit lecture)

MATH 251 Focus on Algebra for Middle School Teachers (5)
Patterns and Formulas. Verbal, Tabular, Graphical, and Symbolic Representations of Numerical Relations. Multiple Approaches to Word Problems. Geometric Models in Elementary Algebra. Activities and use of technology and manipulative materials as they relate to the middle grades curriculum. This course is designed for in-service middle grades teachers of mathematics and is not ordinarily available to pre-service teachers. Prerequisite: Permission of the instructor. (4 units lecture & 1 unit lab)

MATH 252 Geometry, Measurement, and Fractions for Middle School Teachers (5)
Similarity, Equivalent Fractions, Factors and Multiples, Spatial Visualization, Perspective and other Two Dimensional Representations of Solids. Activities and use of technology and manipulative materials as they relate to the middle grades curriculum. This course is designed for in-service middle grades teachers of mathematics and is not ordinarily available to pre-service teachers. Prerequisite: Permission of the instructor. (4 units lecture & 1 unit lab)

MATH 253 Probability, Statistics, and Number Sense for Middle School Teachers (5)
Elementary Probability, Area Models, Surveys, Bar Graphs, Fair and Unfair Games, Expected Value, Measures of Central Tendency and Dispersion. Number Sense and Problem Solving activities using patterns, formulas, tables, estimation and mental arithmetic, and other strategies. Activities and use of technology and manipulative materials as they relate to the middle grades curriculum. This course is designed for in-service middle grades teachers of mathematics and is not ordinarily available to pre-service teachers. Prerequisite: Permission of the instructor. (4 units lecture & 1 unit lab)

MATH 254 Data Analysis and Modeling for Middle School Teachers (5)
Data Collection: Surveys, Experiments and Public Databases. Randomness and Probabilistic Simulations of Natural Processes. Discrete, Linear and Exponential Models for Physical and Social Phenomena. Residual Analysis, and Measures of Goodness of Fit Activities and use of technology and manipulative materials as they relate to the middle grades curriculum. This course is designed for in-service middle grades teachers of mathematics and is not ordinarily available to pre-service teachers. Prerequisite: Permission of the instructor. (4 units lecture & 1 unit lab)

MATH 277 Special Topics in Mathematics (1-5)
Analysis of contemporary and interdisciplinary problems. Topics and prerequisites to be announced. (0 or 3 units lecture & 5 or 2 unit lab)

MATH 281 Tutoring in Precalculus and Calculus (1)
Course covers topics from developmental mathematics, precalculus and calculus (201, 202, 211, 212). Students work on problems related to the math class in which they are concurrently enrolled with the help of a facilitator. (1 unit lecture)

MATH 289 Experiential Prior Learning (5)
Evaluation and assessment of learning which has occurred as a result of prior off-campus experience relevant to the curriculum of the department. Requires complementary academic study and/or documentation. Available by petition only, on a credit, no-credit basis. Not open to post-graduate students. Interested students should contact the Department of Mathematics. (4 units lecture & 1 unit lab)

**Upper Division**

**MATH 300 Sets and Logic (5)**
Investigation of the fundamental tools used in writing mathematical proofs, including sentential and predicate calculus, topics from naive set theory, Cartesian products, partitions, equivalence relations, functions, countability, recursion, the binomial theorem and mathematical induction. This course relies heavily on problem solving and writing complete, logically consistent arguments to illustrate the correct use of the logical tools and methods discussed. Prerequisite: MATH 202. (4 units lecture & 1 unit lab)

**MATH 301 Modern Algebra (5)**
Study of the basic algebraic systems of mathematics. Topics include integers, Euclidean Algorithm, modular arithmetic, rational numbers, real numbers, complex numbers, polynomial rings, and basic group theory. Prerequisite: MATH 300. (4 units lecture & 1 unit lab)

**MATH 301B Classical Algebra Connections (1)**
Weekly seminar discussions to focus on connections between university mathematics and the mathematics that prospective secondary mathematics teachers will be teaching. Course includes 20 hours of observation in middle or high schools. Observations will include opportunities for prospective teachers to interact with middle/high school students in small group instructional settings. This course will include an introduction to live-text. Co-requisite: MATH 301. (1 unit lecture)

**MATH 302 Ordinary Differential Equations (5)**
First-order differential equations; linear differential equations; linear systems; Laplace transforms and/or series solutions of second-order linear equations; geometric approach to nonlinear differential equations and to questions of stability. Cross-listed as MATH 205. Prerequisite: A grade of C- or better in MATH 203. (4 units lecture & 1 unit lab)

**MATH 304 Calculus IV (5)**
Lagrange multipliers; polar, cylindrical and spherical coordinates; double integrals; triple integrals; vector calculus, including line and surface integrals, the Fundamental Theorem of Line Integrals, and the theorems of Green, Stokes, and Gauss; selected topics. This course may make use of computer algebra systems. Cross-listed as MATH 204. Prerequisite: A grade of C- or better in MATH 203. Students without credit in MATH 222 or CMPS 222 are required to enroll in either concurrently. (4 units lecture & 1 unit lab)

**MATH 305 Numerical Analysis (5)**
Number representation and basic concepts of error; numerical solutions of nonlinear equations and systems of equations; interpolation and extrapolation; numerical differentiation and integration; numerical solutions of ordinary differential equations; approximation by spline functions. Cross-listed as CMPS 305. Prerequisites: (1) MATH 203, and (2) CMPS 221 or equivalent.

**MATH 312 Complex Variables (5)**
Complex numbers; analytic functions; conformal mapping; integrals; Cauchy's Theorem and the calculus of residues; power series. Prerequisite: MATH 204. (4 units lecture & 1 unit lab)

**MATH 320 Number Systems, Statistics and Probability (5)**
Continuation of the development of the real numbers including applications and models of rational numbers, irrational numbers, percent, and proportional reasoning. Introduction to the basic notions of chance and probability. Introduction to data analysis and statistics. This course involves substantial use of 2- and 3-dimensional concrete materials in a cooperative learning laboratory setting. Required for entry
into the CSUB Multiple Subjects Credential Program. Prerequisites: A grade of C- or better in Math 221. (4 units lecture & 1 unit lab)

**MATH 321 Introduction To Modern Geometry (5)**
Introduction to the geometry of plane and solid shapes. Networks and applications. Constructions, congruence, and similarity. Concepts of measurement. Motion geometry and tessellations. The use of calculators and/or dynamical geometry software in discovery and problem solving. This course involves substantial use of 2- and 3-dimensional concrete materials in a cooperative learning laboratory setting. Required for entry into the CSUB Multiple Subjects Credential Program. Prerequisites: A grade of C- or better in Math 320. (4 units lecture & 1 unit lab)

**MATH 330 Linear Algebra (5)**
Matrices and systems of linear equations; vector spaces, dimensions, linear independence; spaces associated with matrices; bases, change of basis, orthogonal bases; linear transformations, matrix representation; eigenvalues and eigenvectors, diagonalization; selected applications. Prerequisite: MATH 203, and MATH 222 or CMPS 222. Prerequisite or co-requisite: MATH 300 or CMPS 295. (3 units lecture & 2 unit lab)

**MATH 331 Algebraic Structures I (5)**
Introduction to binary operations and algebraic structures; groups, rings, integral domains, and fields. Prerequisite: (1) MATH 300, and (2) 330 (MATH 330 may be taken concurrently). (4 units lecture & 1 unit lab)

**MATH 338 Analysis of Variance and Experimental Design (5)**
Single-factor ANOVA; multiple comparisons; completely randomized design; fixed and random effects; two-factor ANOVA; randomized complete block design; factorial models; fixed, random, and mixed models; nested models. Use of statistical packages. Prerequisite: MATH 140. (4 units lecture & 1 unit lab)

**MATH 339 Regression Analysis (5)**
Least squares; simple linear regression; correlation analysis; residual analysis; multiple regression; model selection techniques; logistic regression. Use of statistical packages. Prerequisite: MATH 140. (4 units lecture & 1 unit lab)

**MATH 340 Probability Theory (5)**
Sample spaces and events; counting problems, permutations and combinations; conditional probability; independence; Bayes theorem; discrete and continuous random variables; bivariate, multivariate, marginal, and conditional distributions; functions of random variables; expected value, moments, variance, covariance, and correlation; distribution theory including Bernoulli, binomial, hypergeometric, Poisson, uniform, normal, exponential, gamma, and beta distributions; central limit theorem. Prerequisite: MATH 203. Prerequisite or co-requisite: MATH 300 or CMPS 295. (3 units lecture & 2 unit lab)

**MATH 350 Introduction to Mathematical Modeling (5)**
Course designed to give the student an early introduction to the construction and use of empirical and analytic mathematical models from areas such as economics, game theory, integer programming, mathematical biology and mathematical physics (topics depend on instructor). Course evaluation will involve at least one extended project. Prerequisite: MATH 205 (4 units lecture & 1 unit lab)

**MATH 360 Euclidean Geometry (5)**
Elaboration of concepts in Euclidean geometry and 19th- and 20th-century expansions of Euclid’s work. Topics include concurrency of lines in a triangle, collinearity of some points in a triangle, symmetric points in a triangle, some properties of triangles and quadrilaterals, equicircles and the nine-point circle. Additional topics may be included. Ability to write formal synthetic and analytic proofs is stressed. Dynamical Geometry software is used for exploration and discovery. This course provides a survey of material needed to prepare students to teach high school geometry courses. Prerequisites: (1) MATH 300, and (2) 330 (MATH 330 may be taken concurrently). (4 units lecture & 1 unit lab)
MATH 363 Introduction to Analysis I (5)
Development of a rigorous foundation for analysis; axioms for the real numbers; sequences and series;
continuity; introduction to differentiability and integration. Prerequisites: (1) MATH 203, and (2) MATH
300. (4 units lecture & 1 unit lab)

MATH 402 Partial Differential Equations (5)
Fourier series; classical partial differential equations such as heat equation, wave equation, and Laplace
equation; Sturm-Liouville problems; orthogonal functions; topics from Fourier transform or calculus of
variation. Prerequisites: (1) MATH 204 and (2) MATH 205. (4 units lecture & 1 unit lab)

MATH 420 Foundations of Geometry (5)
Study of the classical axiomatization of Euclidean geometry. Hilbert’s incidence, congruence, similarity,
separation, betweenness and continuity axioms are discussed. Special attention is paid to the Parallel
Postulate and its alternative formulations, with an introduction to non-Euclidean geometries. Prerequisite:
MATH 300. (4 units lecture & 1 unit lab)

MATH 425 Modern Mathematics for Teachers (5)
Course intended for prospective teachers of middle and high school mathematics, and includes
investigations relevant to the California Mathematics Contents Standards from the areas of number
theory, algebra, geometry, probability, and statistics. The course emphasizes problem solving and
laboratory activities. Students are introduced to appropriate use of current pedagogical technologies.
Prerequisite: Successful completion of 30 quarter units of college mathematics. (4 units lecture & 1 unit
lab)

MATH 427 Mathematics Curriculum and Instruction for Secondary Teachers (5)
Required during Stage III of the program of all candidates for a Single Subject Secondary Teaching
Credential in Mathematics. The content is designed to acquaint the candidates with the pedagogical
techniques, philosophies, and practices utilized by successful secondary mathematics teachers and
required by the Teaching Performance Expectations as delineated in the Standards of Quality and
Effectiveness for Teacher Preparation Programs. The course includes at least ten hours of field
experience in a high school or middle school mathematics classroom. This course does not count
toward a major or a minor in mathematics. Cross-listed as EDSE 405. (5 units lecture)

MATH 430 Number Theory (5)
Elementary theory of the natural numbers, including prime numbers and divisibility, congruences,
number-theoretic functions, Diophantine equations, and selected topics. Prerequisite: MATH 300, and
MATH 222 or CMPS 222. (4 units lecture & 1 unit lab)

MATH 431 Algebraic Structures II (5)
Continuation of MATH 331. Galois Theory and selected topics. Prerequisite: MATH 331. (4 units lecture
& 1 unit lab)

MATH 440 Mathematical Statistics (5)
Statistical inference; prior and posterior distributions, Bayes estimation, maximum likelihood estimation,
method of moments; derivation of sampling distributions and their properties; unbiased estimators, Fisher
information; theory of confidence intervals and hypothesis testing; power, t-test and F-test; analysis of
categorical data, goodness of fit and contingency tables; inference for linear statistical models, regression
and ANOVA. Prerequisites: MATH 340. (4 units lecture & 1 unit lab)

MATH 450 Introduction to the History of Mathematics (5)
Development of mathematics from its empirical origins to its present form. Prerequisites: (1) MATH 300;
(2) At least two mathematics courses numbered above 300; and (3) Completion of CSUB’s Graduation
Writing Assessment Requirement (GWAR). (4 units lecture & 1 unit lab)

MATH 463 Introduction to Analysis II (5)
Continuation of MATH 363; the fundamental theorem of calculus; further topics of Riemann integration; Taylor’s theorem with remainder; uniform convergence and Taylor series; the topology of the real line; other selected topics if time allows. Prerequisite: MATH 363. (4 units lecture & 1 unit lab)

MATH 477 Special Topics in Mathematics (1-5)
Topics and prerequisites to be announced. Permission of instructor. (4 units lecture & 1 unit lab)

MATH 480 Research Participation (1-5)
Supervised mathematical investigation. May be repeated. Offered on a credit, no credit basis only. Prerequisite: Permission of instructor. (5 units lecture)

MATH 489 Experiential Prior Learning (1-5)
Evaluation and assessment of learning which has occurred as a result of prior off-campus experience relevant to the curriculum of the department. Requires complementary academic study and/or documentation. Available by petition only, on a credit, no-credit basis. Not open to post-graduate students. Interested students should contact the Department of Mathematics. (5 units lecture)

MATH 490 Senior Seminar (5)
Preparation of papers and discussion by faculty and students. Prerequisites: (1) At least four upper-division courses from the Applied, Statistics or Theoretical Tracks; and (2) Completion of CSUB’s Graduation Writing Assessment Requirement (GWAR). (5 units lecture)

MATH 491 Senior Seminar in Mathematics for Prospective Teachers (5)
Students will make presentations on, write papers about, and discuss solutions of mathematical problems grounded in secondary school mathematics education. The focus is mathematics with appropriate inclusion of pedagogical ideas. For students in the Blended Program there is a requirement of 25 hours of supervised field experience in middle or high school mathematics classrooms. Prerequisites: (1) At least four upper-division courses from the Teaching Track; and (2) Completion of CSUB’s Graduation Writing Assessment Requirement (GWAR). (5 units lecture)

MATH 492 Senior Honors Thesis (5)
Individual study with a faculty sponsor leading to a formal written report on a specific topic or problem. Prerequisites: (1) Senior standing; and (2) consent of faculty sponsor; and (3) approval of the Chair of the Department of Mathematics. (5 units lecture)

MATH 494 Senior Seminar for Elementary/Middle School Mathematics Teachers (5)
Students will make presentations on, write papers about, and discuss solutions of mathematical problems grounded in elementary and middle school mathematics education with special emphasis on middle school. The focus is mathematics with appropriate inclusion of pedagogical ideas. Appropriate uses of current pedagogical technologies are discussed. Prerequisites: (1) MATH 321 (or the equivalent), (2) MATH 192 (or a course which has MATH 192 as a prerequisite) may be taken concurrently, and (3) Completion of CSUB’s Graduation Writing Assessment Requirement (GWAR). (5 units lecture)

MATH 496 Internship in Mathematics (1-5)
Internships may be arranged by the department with various agencies, businesses, or industries. The assignments and coordination of work projects with conferences and readings, as well as course credits, evaluation, and grading, are the responsibility of the faculty liaison (or course instructor) working with the field supervisor. Offered on a credit, no credit basis only. (5 units lecture)

MATH 497 Cooperative Education (1-5)
Class offers a sponsored learning experience in a work setting, integrated with a field analysis seminar. The field experience is contracted by the Cooperative Education office on an individual basis, subject to approval by the department. The field experience, including the seminar and reading assignments, is supervised by the cooperative education coordinator and the faculty liaison (or course instructor), working with the field supervisor. Students are expected to enroll in the course for at least two quarters. The
determination of course credits evaluation and grading are the responsibility of the departmental faculty. Offered on a credit, nocredit basis only. (1-5 units lecture)

GRADUATE COURSES

Graduate courses are listed in the “Graduate Studies” section of the catalog.