

## College of Natural, Applied and Health Sciences

The mission of the College of Natural, Applied and Health Sciences is consistent with the overall mission of the University. The College of NAHS has strong, quality program offerings in the sciences and health professions. The faculty and staff are committed to providing relevant education and services to a diverse student population. The goal is to prepare students to think critically and creatively so that they can adapt to changing social, economic and technological conditions. Building external collaborations with major technological corporations and the health care industry is an integral part of the colleges outreach mission, which enables it to provide valuable services to the community as well as increased opportunities for students.

We are proud to have been designated the Flagship State University for the Health Professions. Our graduates can be found practicing in hospitals and other health care agencies across New Jersey. Also, our programs in the Sciences have a long distinguished record of service to this region. So, whether you are looking to study in the Natural and Physical Sciences, Health Care, Mathematics, Technology, or Computer Science, you will gain a strong foundation at the College of Natural, Applied and Health Sciences.

*Interim Dean, Pablo Zafra*

*Assistant to the Dean, Lourdes F. Prieto*

*B-104, (908) 737-3600*

### ACADEMIC DEGREES, PROGRAMS

#### B.A. in Biology

- General Option
- Honors Option
- Teacher Certification Option
- Teacher of Students with Disabilities Option

#### B.S. in Biology

- General Option
- Biotechnology Option

#### B.A. in Chemistry

- General Option
- Preprofessional Option
- Teacher Certification Option

#### B.S. in Chemistry, Expanded Option

#### B.S. in Computer Science

- Information Systems Option

#### B.A. in Earth Science

- General Option
- Teacher Certification Option
- Teacher of Students with Disabilities Option

#### B. S. in Earth Science

- Earth System Science Option
- Geology Option
- Meteorology Option

#### B.A. in Mathematical Sciences

- Teacher Certification Option
- Teacher of Students with Disabilities Option

#### B.S. in Computer Integrated Design and Manufacturing Technology

#### B.S. in Electronics Technology

#### B.S. in Telecommunications and Information Technology

### HEALTH PROFESSIONS

#### B.S. in Health Information Management

- General Option
- Occupational Therapy Track

#### B.S. in Medical Technology

- General Option
- Cytotechnology Option
- Histotechnology Option

#### B.S.N. in Nursing

#### Post Baccalaureate School Nurse Program

### JOINT (OR COMBINED) DUAL DEGREE PROGRAMS

#### B.S. in Health Information Management/ M.S. Management Information Systems

#### B.S. in Health Information Management/ M.A. Communication Studies

#### B.A. / M.S. in Occupational Therapy

#### B.A. / DPT Physical Therapy (with UMDNJ)

### COLLABORATIVE PROGRAM

BA in Elementary Education Liberal Studies in Mathematics, Science, and Technology:

- Biology Specialization
- Earth Science Specialization
- Mathematics Specialization
- Technology Specialization

### DEPARTMENTS, FACULTY

#### Biological Sciences

Faculty: Codella, Field, Glazer, Hayat, James, Mancarella (Chairperson), Osborne, Porta, Pu, Rosenthal, Vassiliou, Yu, Zhang

#### Chemistry-Physics

Faculty: Castiglione, Criasia (Chairperson), Gao, Getzin, Hicks, Kampa, Kubow, Lees, Shin, Stokes-Huby, Vitale, Zarrilli

#### Geology and Meteorology

Faculty: Croft, Dobosiewicz, Krall, Kroll, Manfrino, Metz (Chairperson), Murphy, Ngoy, Yoh, Zois

#### Mathematics and Computer Science

Faculty: Abeles, Affouf, Alsina, Arnow, Avirappattu, Beaugris, Chang, Deavours, Emanouilidis, Hahn (Chairperson), Halper, Krantz, Lehmann, Lipson, Mathur, Narasimhan, Ryder, Santomauro, Stewart-Gardiner, Tse, Viglione, Wang, Wittenberg, Woubneh, Zafra

#### Technology

Faculty: Behi, Cokewood, Shahrabi (Chairperson)

#### Health Information Management

Faculty: Davis, Manger (Chairperson)

#### Medical Technology

Coordinator: Osborne

#### Nursing

Faculty: Campbell (Chairperson), Fitzgerald, Fitzsimons, Hascup, Krause-Parello, Neville, Pisani

#### Occupational Therapy

Faculty: Knis-Matthews, Richard, Stern (Chairperson)

# Mathematical Sciences

Chairperson: Dr. Susan Hahn  
C232, (908) 737-3704

A major in the mathematical sciences is designed to fulfill several objectives: to develop mathematical reasoning through problem solving; to investigate the mathematical theory which facilitates an understanding of mathematical applications; to provide background for careers in applied mathematics and computer science or teaching of secondary school mathematics; to prepare for graduate studies in the mathematical sciences. These are achieved, with departmental advisement, through the appropriate selection of electives.

## B.A. DEGREE MATHEMATICAL SCIENCES

### GENERAL EDUCATION REQUIREMENTS 49-53

#### FOUNDATIONS REQUIREMENTS 13

GE 1000	Transition to Kean	1
ENG 1030	College Composition	3
MATH 1000	Algebra for College Students #	3
COMM 1402	Speech Communication as Critical Citizenship	3
GE 2024	Research & Technology	3

#### DISCIPLINARY/INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS

Humanities	9
*ENG 2403	World Literature 3
Select two courses from different areas:	
Fine Arts or Art History	3
Philosophy or Religion	3
Foreign Languages	3
Music or Theatre	3
Interdisciplinary	3
Social Sciences	9
*HIST 1000	History of Civil Society in America 3
Select two courses from different areas:	
Economics or Geography	3
Political Science	3
Psychology	3
Sociology or Anthropology	3
Interdisciplinary	3
Science & Mathematics	10-11
*MATH 1054	Precalculus ## 3
Select two courses - one must be a lab science:	
Physics 2091	General Physics I 4
<b>OR</b>	
Physics 2095	Physics I (Recommended) 4
Biology <b>OR</b> Chemistry or Physics <b>OR</b>	
Astronomy, Geology, Meteorology, or ES, <b>OR</b>	
Interdisciplinary	3, 4

Health/Physical Education	2-3
ID 1010	Leisure & Rec In Multicultural Soc

<b>OR</b>	
ID 1225	Issues Contemporary Health 3

<b>OR</b>	
Physical Education	2

*Concentration* 6-8  
A concentration is a two-course sequence in the Liberal Arts and Sciences, outside the major, that builds upon an introductory GE Distribution course.

\*Required Distribution Course

#### ADDITIONAL REQUIREMENTS 8

CPS 1231	Fund. of Comp. Science 4
CPS 2231	Comp. Org. & Prog. 4

#### MAJOR REQUIREMENTS 40

Required Courses	25
MATH 2411	Calculus I 3
MATH 2412	Calculus II 3
MATH 2800	Mathematical Software 1
MATH 2995	Matrix & Linear Algebra 3
MATH 3110	Introduction to Proofs 3
MATH 3451	Calculus III 3
MATH 3452	Calculus IV 3
MATH 3455	Differential Equations 3
MATH 3544	Probability & Math Stat. 3
Major Electives	12
Selected with departmental advisement at the 3000-4000 level.	
Major/GE Capstone Course	
MATH 4890	Senior Seminar in MATH (WE) 3

#### FREE ELECTIVES 23-27

(50% of free electives must be taken at the 3000-4000 level)  
Additional courses in Computer Science, Physics or other Sciences, Technology, Economics or Management Science recommended.

#### TOTAL 124

# Students eligible to take MATH 1054  
Precalculus based on their placement test may take that course in place of MATH 1000 and take an additional three credits in Free Electives to total 124 S.H.  
## Students eligible to take MATH 2411 Calculus I based on their placement test may take that course in place of MATH 1054. In that case, MATH 2411 will fulfill the Distribution requirement and the student may take an additional three credits in Free Electives to total 124 S.H.

## B.A. DEGREE MATHEMATICAL SCIENCES

### OPTION: STATISTICS

Coordinator: Dr. Wolde Woubneh, (908) 737-3712

### GENERAL EDUCATION REQUIREMENT 49-53

#### FOUNDATIONS REQUIREMENTS<sup>2</sup>: 13

GE 1000	Transition to Kean	1
ENG 1030	College Composition <sup>3</sup>	3
MATH 1000	Algebra for Coll. Students <sup>4</sup>	3
COMM 1402	Speech Comm As Crit. Cit.	3
GE 2024	Research & Technology	3

#### DISCIPLINARY/INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS:

Humanities	9
*ENG 2403	World Literature 3
(Select two courses from different areas)	
Fine Arts or Art History	3
Philosophy or Religion	3
Foreign Languages <sup>5</sup>	3
Music or Theatre	3
Interdisciplinary	3
Social Sciences	9
*HIST 1000	Hist of Civil Soc. in Amer. 3
(Select two courses from different areas)	
Psychology	3
Economics or Geography	3
Political Science	3
Sociology or Anthropology	3
Interdisciplinary	3

#### Science & Mathematics 10-11

*MATH 1054	Precalculus <sup>4</sup> 3
(Select two courses - one must be a lab sci)	
Physics 2091	General Physics I <b>OR</b>
Physics 2095	Physics I (Recommended) 4
Biology <b>OR</b> Chemistry <b>OR</b> Physics <b>OR</b>	
Astronomy, Geology, Meteorology, ES, <b>OR</b>	
Interdisciplinary	3,4

#### Health/Physical Education 2,3

ID 1225	Issues Contemporary Health 3
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<b>OR</b>	
Physical Education	1
Physical Education	1

#### Concentration<sup>6</sup> 6-8

#### ADDITIONAL REQUIREMENTS 8

CPS 1231	Fund. of Comp. Science 4
CPS 2231	Comp. Org. & Prog. 4

**MAJOR REQUIREMENTS<sup>3</sup> 40****REQUIRED COURSES 18**

Math 2411	Calculus I	3
Math 2412	Calculus II	3
Math 2995	Matrix & Linear Algebra	3
Math 3451	Calculus III	3
Math 3452	Calculus IV	3
Math 3544	Probability & Math. Stat.	3

**STATISTICS CONCENTRATION 22**

Math 2526	Applied Statistics	3
Math 3500	Statistical Software	1
Math 3526	Applied Statistics II	3
Math 3560	Regression Analysis	3
Math 3580	Experimental Design	3
Math 3590	Sampling Techniques	3
Math 4500	NonParametric Statistics	3

Choose ONE of the following

Math 3570	Multivariate Analysis	3
Math 4545	Applications of Mathematics Statistics	3
Math 4550	Statistical Quality Control I	3
Math 4560	Actuarial Mathematics I	3

**MAJOR/GE CAPSTONE COURSE<sup>3</sup>**

Math 4890	Senior Seminar in Math	3
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**FREE ELECTIVES: 21-25**

(50% of free electives must be taken at the 3000-4000 level)

<sup>1</sup> Required of all Freshmen and Transfers with fewer than 10 credits.<sup>2</sup> See prerequisites and equivalencies on page 33.<sup>3</sup> Eng 1030 College Composition and all major courses, including the Capstone, require a grade of C or better.<sup>4</sup> Students whose qualifying score on the placement test makes them eligible to take either Math 1054 or Math 2411 may take that course instead. In that case, Math 1054 or Math 2411 will count as the General Ed requirement and the student may take another 3 or 6 credits as free electives to total 125S.H.<sup>5</sup> Credit granted only upon the completion of two semesters of elementary or intermediate foreign language. Three credits may be applied to Humanities and three credits may be applied to Free Electives.<sup>6</sup> Not required of students with a second major, minor or collateral.

\* Required Distribution Course

**B.A. DEGREE MATHEMATICAL SCIENCES****OPTION: TEACHER CERTIFICATION**

Students choosing this (K-12) option must make a formal application for admission to the Elementary, Middle and Secondary Education (EMSE) Department. Prior to taking education courses, all prerequisites must be met. See the description under the College of Education.

**GENERAL EDUCATION AND ADDITIONAL LIBERAL ARTS REQUIREMENTS 61-62****GENERAL EDUCATION REQUIREMENTS 44-45****FOUNDATIONS REQUIREMENTS 13**

GE 1000	Transition to Kean	1
ENG 1030	College Composition	3
MATH 1000	Algebra for College Students #	3
COMM 1402	Speech Communication as Critical Citizenship	3
GE 2024	Research & Technology	3

**DISCIPLINARY/INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS**

Humanities	9	
*ENG 2403	World Literature	3
Select two courses from different areas:		
Fine Arts or Art History	3	
Philosophy or Religion	3	
Foreign Languages	3	
Music or Theatre	3	
Interdisciplinary	3	

**Social Sciences 9**

*HIST 1000	Hist of Civil Society in America	3
PSY 1000	Gen Psychology	3
SOC 1000	Intro to Sociology	3

**OR ANTH 1800 Cultural Anthropology 3****Science & Mathematics 10-11**

*MATH 1054	Precalculus ##	3
PHYS 2095	Physics I	

**OR PHYS 2091 General Physics I 4**

Biology **OR** Chemistry, Physics **OR** Astronomy, Geology, Meteorology, **OR ES OR** Interdisciplinary 3, 4

**Health/Physical Education 3**

ID 1225	Issues Contemporary Health	3
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\* Required Distribution Course

**ADDITIONAL REQUIREMENTS 17**

CPS 1231	Fund of Computer Science	4
CPS 2231	Comp Org and Prog	4
PSY 2110	Psychology of Adolescence	3
Two additional DIS/ID Courses		6

(Physics, Computer Science or Economics recommended)

**MAJOR REQUIREMENTS 40**

Required Courses			28
MATH 2411	Calculus I	3	
MATH 2412	Calculus II	3	
MATH 2800	Mathematical Software	1	
MATH 2995	Matrix & Linear Algebra	3	

MATH 3110	Introduction to Proofs	3
MATH 3342	Eucl. & Non-Eucl. Geom.	3
MATH 3451	Calculus III	3
MATH 3452	Calculus IV	3
MATH 3455	Differential Equations	3
MATH 3544	Probability & Math. Statistics	3

Major Electives 9

Selected with departmental advisement at the 3000-4000 level.

Major/GE Capstone Course 3

MATH 4890	Senior Seminar in Math (WE)	3
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**PROFESSIONAL EDUCATION 30**

Sophomore Level		
EMSE 2801	Intro to Fld Exp Subj. Area K-12	3

**Junior Level**

EDUC 3000	Curr. Inst. Eval. & Learner	3
EDUC 3401	Lang Arts/Reading K-12	3
EMSE 3122	Computers in Education	3
EMSE 3220	Mathematics Ed. K-12 WE	3
EMSE 3801	Field Exp. Subj Area K-12	2
EMSE 3903	Teaching Eng Lang Learning I	1

**Senior Level**

EMSE 4801	Prof. Internship/ Subj. Area K-12	9
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**PROFESSIONAL/GE CAPSTONE 3**

EDUC 4000	Teacher and Classroom	3
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**FREE ELECTIVES 0-1**

(50% of free electives must be taken at the 3000-4000 level)

**TOTAL 132**

# Students eligible to take MATH 1054 Precalculus based on their placement test may take that course in place of MATH 1000 and take an additional three credits in Free Electives to total 132 S.H. Students in teacher education programs must take the three credits in a liberal arts discipline.

## Students eligible to take MATH 2411 Calculus I based on their placement test may take that course in place of MATH 1054. In that case, MATH 2411 will fulfill the Distribution requirement and the student may take an additional three credits in Free Electives to total 132 S.H. Students in teacher preparation programs must take the three credits in a liberal arts discipline.

**B.A. MATHEMATICS / TEACHER OF STUDENTS WITH DISABILITIES (76298)**

Students who wish to be certified in both Mathematics K-12 and Educator of Students with Disabilities should consult the Catalogue under Special Education programs for a complete description of this dual certification program.

## B.A. DEGREE IN ELEMENTARY EDUCATION

### OPTION: LIBERAL STUDIES IN MATHEMATICS, SCIENCE, AND TECHNOLOGY

### MATHEMATICS SPECIALIZATION K-5 AND 5-8

This is a joint program with the College of Education designed to provide elementary education students the opportunity to pursue a specialization in science, mathematics, or technology. Students choosing this option must make a formal application for admission to the Elementary, Middle and Secondary Education Department. Prior to taking education courses, all prerequisites must be met. Please refer to the Elementary Education program description under the College of Education.

### GENERAL EDUCATION AND ADDITIONAL LIBERAL ARTS REQUIREMENTS

#### GENERAL EDUCATION REQUIREMENTS

#### FOUNDATIONS REQUIREMENTS

GE	1000	Transition to Kean	1
ENG	1030	College Composition	3
MATH	1000	Algebra for College Students #	3
COMM	1402	Speech Communication as Critical Citizenship	3
GE	2024	Research & Technology	3

#### DISCIPLINARY/INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS

<i>Humanities</i>			
ENG	2203	Landmarks of World Lit	3
AH	1700	Art History	3
MUS	1050	Music Fundamentals (Rec.)	3
<i>Social Sciences</i>			
HIST	1000	History of Civil Society in America	3
PSY	1000	General Psychology	3
GEOG	2010	World Geography	3
<i>Science &amp; Mathematics</i>			
MATH	1010	Foundations of Math	3
BIO	1000	Principles of Biology	4
PHYS	2091	General Physics I	
<b>OR</b>			
PHYS	1000	Intro to Physics	4
<i>Health/Physical Education</i>			
ID	1225	Issues Contemporary Health	3
PED	1101	<b>OR</b> 1103 <b>OR</b> 1105	1

#### ADDITIONAL COURSES

PSY	2100	Child Psychology	3
PSY	2110	Psychology of Adolescence	3
HIST	2303	U.S. History to 1877	3
HIST	2304	U.S. History 1877 to Present	3

ID	2950	The Child and Technology	3
ID	2955	Disabled Person In Amer Soc	3

### ACADEMIC MAJOR REQUIREMENTS

### MATH/SCIENCE/TECHNOLOGY BASIC REQUIREMENTS

<i>Mathematics</i>			
MATH	1016	Statistics	3
MATH	1054	Precalculus	3
<i>Biology</i>			
BIO	2200	Cell Biology	4
<b>OR</b>			
Biology Elective			
<i>Earth Science</i>			
Intro course in Astronomy, Geology, Meteorology			
<b>OR</b>			
ES	1000	Observing the Earth	3-4
<i>Technology</i>			
CPS	1231	Fund of Computing	4
CPS	1032	Microcomputer Apps	4

#### **OR**

TECH	2920	Computers In Technology	3
TECH	1100	Technology Systems	3

### MATHEMATICS SPECIALIZATION

MATH	2411	Calculus I	3
MATH	2412	Calculus II	3
MATH	2110	Discrete Structures	3
MATH	2995	Matrix & Linear Algebra	3
MATH	3342	Eucl. & Non-Eucl. Geometry	3
MATH	3891	History of Mathematics	3

### PROFESSIONAL EDUCATION

EMSE	2802	Expl Tchg/Lab Exp	3
EDUC	3000	Curr. Eval. & Learner	3
EDUC	3400	Lang Arts/Read Pre-School & Elem Curr.	3
EMSE	3123	Math & Science in Education	3
EMSE	3140	Soc Studies & Contemp Issues in Educ.	3
EMSE	3300	Middle School Curr & Philosophy	3
EMSE	3802	Field Exp. In Middle School	2
EMSE	3903	Teaching ELL	1
EMSE	4800	Prof. Internship Elem Teach & Curr	9
EMSE	4900	Senior Seminar (Capstone)	3

### TOTAL 138-139

# Students eligible to take MATH 1054 Precalculus based on their placement test may take that course in place of MATH 1000 and take an additional three credits as Free Electives to total 133 S.H. Students in teacher preparation programs must take the three credits in a liberal arts discipline.

## MINOR

### MATHEMATICAL SCIENCES MINOR

The Mathematical Sciences Minor will be granted upon completion of 18 semester hours of Mathematics courses at the 2000 level or above. Required courses are MATH 2411 and MATH 2412. Of the remaining 12 semester hours, 6 must be at the 3000 level or above.

### STATISTICS MINOR

#### REQUIREMENTS 18

MATH	2411	Calculus I	3
MATH	2412	Calculus II	3
MATH	2026*	Statistical Decision Theory	
<b>OR</b>			
MATH	2526	Applied Statistics	3
MATH	3544	Probability and Mathematical Statistics	3
MATH	3570	Multivariate Analysis	3
MATH	4545	Applications of Mathematical Statistics	3

\*For computer science majors only.

#### ELECTIVES

(Choose one of the following)			
MATH	2036	Non-Parametric Statistics	3
MATH	3511	Games and Gambling	3
MATH	4805	Mathematical Modeling	3
MATH	4999	Work Study Cooperative Education in Statistics	3

### TOTAL 21

## MATHEMATICS COURSES

### ELEMENTARY MATHEMATICS

#### MATH 1000 Algebra for College Students (3)

Operations with real numbers, polynomial expressions, exponents, rational and radical expressions. Solutions of linear and nonlinear equations and inequalities. Solutions of linear and nonlinear systems of equations. Introduction to functions and their graphs. MATH 1000 is the one-semester non-extended format of Algebra for College Students. Fulfills the General Education Algebra requirement. Three degree credits. Prerequisite: Placement by the Developmental Studies Office.

General Education Foundation Course

#### MATH 1001 Algebra for College Students

Operations with real numbers, polynomial expressions, exponents, rational and radical expressions. Solutions of linear and nonlinear equations and inequalities. Solutions of linear and nonlinear systems of equations. Introduction to functions and their graphs. MATH 1001 is a component of the one-semester extended format of Algebra for College Students. MATH 1001 and MATH 1002, which must be taken concurrently, fulfill the General Education algebra requirement. Three institutional credits.

*Prerequisite: Placement by the Developmental Studies Office.*

*Corequisite: MATH 1002.*

*General Education Foundation Course*

**MATH 1002 Algebra for College Students (3)**

Operations with real numbers, polynomial expressions, exponents, rational and radical expressions. Solutions of linear and nonlinear equations and inequalities. Solutions of linear and nonlinear systems of equations. Introduction to functions and their graphs. MATH 1002 is a component of the one-semester extended format of Algebra for College Students. MATH 1001 and MATH 1002, which must be taken concurrently, fulfill the General Education algebra requirement. Three degree credits.

*Prerequisite: Placement by the Developmental Studies Office.*

*Corequisite: MATH 1001*

*General Education Foundation Course*

**MATH 1003 Algebra for College Students (3)**

Operations with real numbers, polynomial expressions, exponents, rational and radical expressions. Solutions of linear and nonlinear equations and inequalities. Solutions of linear and nonlinear systems of equations. Introduction to functions and their graphs. MATH 1003 is the first-semester component of the two-semester extended format of Algebra for College Students. MATH 1003 and MATH 1004, which must be taken sequentially, fulfill the General Education algebra requirement. Three institutional credits.

*Prerequisite: Placement by the Developmental Studies Office.*

*General Education Foundation Course*

**MATH 1004 Algebra for College Students (3)**

Operations with real numbers, polynomial expressions, exponents, rational and radical expressions. Solutions of linear and nonlinear equations and inequalities. Solutions of linear and nonlinear systems of equations. Introduction to functions and their graphs. MATH 1004 is the second-semester component of the two-semester extended format of Algebra for College Students. MATH 1003 and MATH 1004, which must be taken sequentially, fulfill the General Education algebra requirement. Three degree credits.

*Prerequisite: MATH 1003.*

*General Education Foundation Course*

**MATH 1010 Foundations of Mathematics (3)**

An introduction to mathematical reasoning including problem-solving strategies sets and set operations, logic, geometry, and statistics. Mathematics majors cannot receive credit for this course.

*Prerequisite: MATH 1000 or placement by the Developmental Studies Office*

*Approved General Education Distribution Course*

**MATH 1013 Finite Mathematics with Applications (3)**

Sets, counting, probability, matrices, and linear programming. Practical applications of contemporary mathematics and mathematical models. For non-science majors.

*Prerequisite: MATH 1000 or placement by the Developmental Studies Office*

**MATH 1016 Statistics (3)**

Descriptive and inferential statistics: graphic treatment of data, characteristics of distributions, statistical models, correlation, regression, estimation and hypothesis testing. Computer applications.

*Prerequisite: MATH 1000 or placement by the Developmental Studies Office*

*Approved General Education Distribution Course*

**MATH 1017 Statistics Service Learning Module (1)**

Service learning is the process of incorporating student volunteerism within an academic framework while providing services to the community resulting in the development of skills, knowledge and experience.

*Co-requisite: Must be taken in conjunction with MATH 1016.*

**MATH 1030 Problem Solving in Mathematics (3)**

Development and application of problem solving strategies to a variety of problems within and outside of mathematics making connections between mathematics and other content areas. Numerous and varied experiences with problem solving as a method of inquiry and applications.

*Prerequisite: Completion of any mathematics course 1000 level or above.*

**MATH 1054 Precalculus (3)**

Exponential and logarithmic functions. Trigonometric functions with emphasis on trigonometric identities and trigonometric analysis. Complex numbers, polar coordinates, plane vectors and trigonometric forms of complex numbers. Arithmetic and geometric sequences and series. Problem solving methods. Students will be required to acquire a specified graphing calculator.

*Prerequisites: MATH 1000, or the equivalent, or a qualifying score on the placement examination.*

*Approved General Education Distribution Course*

**LOGIC AND FOUNDATIONS**

**MATH 2110 Discrete Structures (3)**

Sets, logic, relations, methods of proof, counting techniques, recursively defined relations, Boolean algebra, applications to computing.

*Prerequisite: MATH 1054 or equivalent.*

**MATH 3110 Introduction to Proofs (3)**

This course will introduce the student to the motivation and logic behind mathematical proofs. Proofs will be built around topics from basic combinatorics, elementary number theory, elementary abstract algebra and basic graph theory.

*Prerequisite: MATH 2411 or equivalent*

**MATH 3120 Combinatorics (3)**

Sets, counting, permutations and combinations, generating functions, recurrence relations, graphs and their coloring, circuits, trees, and searching. Applications to computing and operations research.

*Prerequisite: MATH 2110.*

**MATH 3155 Mathematical Logic (3)**

A survey of classical and computational logic. The propositional calculus. Introduction to programming in logic. Fundamentals of neural networks.

*Prerequisite: MATH 2110.*

**ALGEBRA**

**MATH 2995 Matrix and Linear Algebra (3)**

Systems of linear equations, matrices, determinants, vector spaces, linear transformations, eigenvalues and eigenvectors, applications.

*Prerequisite: MATH 2411*

**MATH 3225 Computational Methods in Matrix and Linear Algebra II (3)**

Continuation of topics discussed in MATH 2995. Additional topics: inner product spaces, canonical forms, derivatives in higher dimension, systems of differential equations, spectral theory, and their applications in science and economics.

*Prerequisites: MATH 2412, MATH 2995.*

**MATH 3247 Abstract Algebra I (3)**

Elementary group theory: subgroups, cyclic and permutation groups, direct products, Lagrange's Theorem, normal subgroups and quotient groups, homomorphisms and isomorphisms, the Sylow Theorems; use of a computer.

*Prerequisite: MATH 2110 or permission of instructor.*

**MATH 3248 Abstract Algebra II (3)**

Rings, integral domains, fields, ideals and quotient rings, rings of polynomials, homomorphisms, extension field and vector spaces; use of computer.

*Prerequisite: MATH 3247 or permission of instructor.*

**GEOMETRY**

**MATH 3342 Euclidean and Non-Euclidean Geometry (3)**

Euclidean geometry, from Euclid's to Hilbert's axioms; coordinate geometry; transformations; non-Euclidean geometries; finite geometries.

*Prerequisite: MATH 2110.*

**ANALYSIS**

**MATH 2400 Calculus for Business and Economics (3)**

Single variable differential and integral calculus. Algebraic, exponential and logarithmic functions, derivatives, integrals. Applications of calculus to economics and managerial science. May not be substituted for MATH 2411, 2412 sequence.

*Prerequisite: Permission of MIS Program Coordinator and MATH 1054 or the equivalent.*

**MATH 2411 Calculus I (3)**  
Functions, limits, and continuity, differentiation of algebraic and trigonometric functions, tangent and normal lines, Newton's method, optimization and related rate problems. Applications to the physical, biological and managerial sciences. Computer applications. *Prerequisite: MATH 1054 or a qualifying score on the placement test.*

**MATH 2412 Calculus II (3)**  
Antiderivatives, definite integrals, integration of algebraic and transcendental functions, numerical integration, elementary differential equations. Area, volume, arc length, surface area. Applications to the physical, biological and managerial sciences. Computer applications. *Prerequisite: MATH 2411 or permission of the instructor.*

**MATH 3451 Calculus III (3)**  
Indeterminate forms, vector algebra and calculus in the plane and 3-space, analytic space geometry, multivariable functions, partial derivatives, gradients. Optimization problems. Applications to the physical sciences. Computer applications. *Prerequisite: MATH 2412 or permission of the instructor.*

**MATH 3452 Calculus IV (3)**  
Infinite sequences and series, convergence tests, series of functions, power series, Taylor series and polynomials, numerical approximations. Multiple integrals, integral transformations. Vector integral calculus, line and surface integrals, theorems of Green, Gauss and Stokes. Applications to the physical sciences. Computer applications. *Prerequisite: MATH 3451 or permission of the instructor.*

**MATH 3455 Differential Equations (3)**  
First order equations, linear equations, numerical methods, Laplace Transforms and systems of equations. Emphasis on applications of differential equations to the solution of scientific problems from such areas as physical science, biology, economics, psychology and social science. *Prerequisite: MATH 2412 or permission of the instructor.*

**MATH 3940 Numerical Analysis (3)**  
Solution of equations and systems of equations, analysis of errors in numerical methods, numerical differentiation and integration, approximation, interpolation, solutions of differential equations. Use of computers. *Prerequisites: MATH 2412 and CPS 2231 or the equivalent.*

**MATH 4404 Introduction to Applied Mathematics (3)**  
Study of power series solution to differential equations, Bessel functions, Legendre polynomials, partial differential equations, boundary value problems, Fourier series and integrals, the Sturm-Liouville problem and the Gamma function. Computer applications and simulations. *Prerequisite: MATH 3452 or MATH 3455 or permission of instructor.*

**MATH 4451 Advanced Calculus I (3)**  
Fundamental concepts of calculus. Functions of one variable, sequences, limits, continuity, differentiation and integration. *Prerequisite or corequisite: MATH 3452 or permission of instructor.*

**MATH 4452 Advanced Calculus II (3)**  
Functions of several variables, partial differentiation, transformations, power series, uniform convergence, line and surface integrals, and vector analysis, including standard theorems and applications. *Prerequisite: MATH 3452 or permission of the instructor.*

**MATH 4465 Complex Variables (3)**  
Complex numbers, analytic functions, elementary functions and transformations, complex integration, power series, residues, poles, conformal mapping, and applications. *Prerequisite or corequisite: MATH 3452 or permission of the instructor.*

## PROBABILITY AND STATISTICS

**MATH 2026 Statistical Decision Theory (3)**  
An introduction to statistical concepts and methods and their effective application to real-world problems. The construction and evaluation of decision rules as a basis for decision-making. Computer facilities utilized. *Prerequisite: MATH 1054.*

**MATH 2036 Non-Parametric Statistics (3)**  
An introduction to useful and simple techniques that have wide applicability, including models and statistical procedures; one, two, and K-sample techniques; goodness of fit tests; correlation and regression. Use of computers. *Prerequisite: One course in statistics.*

**MATH 2526 Applied Statistics (3)**  
Statistical techniques of univariate and bivariate data analysis, probability, discrete and continuous random variables, sampling distributions, estimation, hypothesis tests about a single population parameter and simple correlation and regression. Computer assisted statistical analysis and interpretation of the results. *Prerequisite: MATH 2411 or permission of the instructor.*

**MATH 3500 Statistical Software (1)**  
Introduction to the statistical software SAS or SPSS. Students learn the fundamentals of the SAS or SPSS software and its applications to descriptive and inferential statistical analysis of various real world problems from social and industrial fields. *Prerequisite: MATH 2526*

**MATH 3511 Games and Gambling (3)**  
Games of chance, combinatorics, probability and game theory. Standard and unusual games are played and then subjected to rational analysis in the face of uncertainty. Historical anecdotes. Role of games in artificial intelligence. Utilization of campus computing equipment. *Prerequisite: A course in statistics or computer science.*

**MATH 3526 Applied Statistics II (3)**  
Statistical inference about a single population and about two populations, analysis of variance, chi-square tests, non-parametric statistical techniques, simple linear regression and correlation, categorical data analysis, introduction to multiple regression. *Prerequisite: MATH 2526 or equivalent*

**MATH 3544 Probability and Mathematical Statistics (3)**  
Descriptive statistics and frequency distribution of a random variable. Sampling distribution of a statistic. Probability: sample spaces, random variables, probability laws and probability distributions of discrete and continuous random variables. Binomial, Poisson, Geometric, Negative Binomial, Hypergeometric, Uniform, Normal, Gamma, Chi-Square and Beta distributions. Mathematical expectation of distributions such as Binomial, Poisson, Gamma, Normal, Chi-Square, Student's t and F distributions. *Prerequisite: MATH 2412 or permission of instructor.*

**MATH 3560 Regression Analysis (3)**  
Introduction to linear regression models with one or more independent variables. Analysis of variance (ANOVA). Estimation of parameters, model building, analysis and diagnostics. Introduction to non-linear estimation. Use of computer software. *Prerequisites: MATH 3526 and MATH 2995*

**MATH 3570 Multivariate Analysis (3)**  
Review of multiple regression and hypothesis testing in multiple regression. Multiple, partial and multiple-partial correlation. Polynomial regression, one-way analysis of variance, two-way analysis of variance, analysis of covariance. Logistic regression, discriminant analysis, path analysis and factor analysis. *Prerequisites: MATH 2995 and a course in statistics.*

**MATH 3580 Experimental Design (3)**  
Introduction to the principles of experimental design and analysis of data from designed experiments with emphasis on applications. Topics include single factor experiments, repeated measures, randomized block designs, Latin squares, factorial experiments, nested models and split-plot designs. Statistical software packages will be utilized. *Prerequisite: MATH 3526*

**MATH 3590 Sampling Techniques (3)**  
Planning and designing sample surveys, the population and the sample, random sampling, systematic sampling, stratified random sampling, ratio estimation, cluster sampling with equal and unequal probability, probability proportional to size sampling, sample design and estimation methodology and sample survey methodology. *Prerequisite: MATH 2526 or equivalent*

**MATH 4500 Non-Parametric Statistical Methods (3)**

The dichotomous data problem, the one-sample and two-sample location problems, distribution-free rank test for dispersion and the difference in two populations; the one-way layout distribution-free tests, multiple comparisons and the two-way layout distribution-free tests. Computers will be utilized.  
*Prerequisite: MATH 3526 or equivalent*

**MATH 4545 Applications of Mathematical Statistics (3)**

Applications of mathematical statistics to decision making in economics, quality control, psychology, and the natural sciences. Estimation, linear statistical models, designing experiments in the analysis of enumerative data, regression and analysis of variance, goodness-of-fit tests, randomized block design and non-parametric statistics.  
*Prerequisite: MATH 3544.*

**MATH 4550 Statistical Quality Control (3)**  
Shewhart's control charts, moving average charts, statistical process-control techniques, capability, stability and quality; charts for binomial and Poisson data counts, three-way control charts, acceptance sampling, estimating fraction nonconforming.. Computers will be utilized.  
*Prerequisite: MATH 3526 or equivalent*

**MATH 4560 Actuarial Mathematics (3)**  
Mathematics of interest, present value of basic annuities, loan repayment, the sinking-fund method, Makeham's formula, bond prices and amortization, spot rates, stocks and options, futures and forward contracts, foreign currency exchange rates. Practical applications in the mathematics of financial analysis.  
*Prerequisite: MATH 3544*

## NUMBER THEORY

**MATH 3624 Number Theory (3)**  
Properties of the integers: divisibility, primes, theory of congruence, Diophantine equations, number theoretic functions with a historical study of important problems. Use of computers.  
*Prerequisite or corequisite: MATH 3451.*

## APPLICATIONS

**MATH 2800 Mathematical Software (1)**  
Introduction to mathematical software. Students apply mathematical software and computer algebra systems to perform numerical and symbolic calculations and to solve computational problems in calculus, matrix theory, differential equations and numerical analysis.  
*Prerequisite: MATH 2411*

**MATH 3815 Cryptology (3)**  
History of cryptography, monoalphabetic substitution, multilateral substitution systems, periodic polyalphabetic ciphers, digraphic substitution, transposition systems, aperiodic systems including simpler varieties of machine ciphers, code systems. Use of computers.

**MATH 3891 History of Mathematics (3)**  
A study of the evolution of the major concepts and processes associated with elementary mathematics from geometry through the invention of calculus. Emphasis is on the mathematical content contributed by many civilizations.  
*Prerequisite: MATH 2412*  
*Writing Emphasis Course*

**MATH 4805 Mathematical Modeling with Applications (3)**  
Techniques of mathematical model construction. An approach for translating real-world phenomena and problems into the language, of mathematics. Use of computers.  
*Prerequisite: MATH 3544 or permission of instructor.*

**MATH 4809 Special Topics in Mathematics (3)**  
Research study of areas in mathematics influenced by contemporary developments as well as interests and needs of students majoring in mathematics. The subject of a semester's work varies, and course may be taken for credit more than once.  
*Prerequisite: Permission of the instructor.*

**MATH 4815 Advanced Cryptanalysis (3)**  
Overview of electronic cryptosystems, bit-stream generation, irreducible and primitive polynomials, Galois fields, sequence complexity, the Berlekamp Massey Theorem, correlation immunity, the Likelihood Ratio Test, exponentiation ciphers, discrete logarithms, public key systems. Use of computers.  
*Prerequisite: MATH 3815 or permission of instructor.*

**MATH 4890 Senior Seminar in Mathematics (3)**  
A capstone seminar to integrate ideas, concepts, and methods from various areas of mathematics. Students will be required to choose a topic in mathematics or a related field for a research paper and presentation to the class. Students will be expected to communicate mathematical ideas by presenting solutions to problems, leading discussions and actively participating in class.  
*Prerequisite: Senior status and completion of core requirements.*  
*Required for Mathematics Majors, Writing Emphasis Course (GE Capstone Course)*

**MATH 4892 The History of Modern Mathematics (3)**  
Selections from the major developments of modern mathematics in calculus, geometry, algebra, number theory, foundations, topology and probability through the first half of the 20<sup>th</sup> century. Primary materials written by great mathematicians on significant topics are analyzed.  
*Prerequisite: Senior status and completion of mathematics core.*

**MATH 4999 Work-Study Cooperative Education in Mathematics/Statistics (3)**  
The cooperative education program allows a student to earn academic credit while gaining valuable job experience by working in industry in an area related to his or her major. All co-op jobs must be approved by a faculty committee after consultation between a faculty coordinator and a job supervisor. Students must complete approximately 120 hours on the job during a regular semester or summer session and fulfill all requirements of the job supervisor and faculty coordinator.  
*Prerequisite: Completion of minimum of 15 semester hours in mathematics/computer science including CPS 1031, MATH 3452, MATH 2110, MATH 4545. Minimum grade point average of 3.0 in major and 2.75 overall. Approval of faculty committee.*