The School of Natural Sciences (SONS) has a goal of preparing students to think critically and creatively and to experience an explicit understanding of physical, chemical, and biological processes. Our programs prepare students to adapt to changing social, economic and technological conditions as well as changes in the health care industry. Our external collaborations with K-12 schools, major technological and environmental corporations and the health care community provide valuable services to the community and important opportunities for our students. The School of Natural Sciences includes both resident and Kean/Ocean faculty of Biology, Chemistry, and Physics. We provide training and experiences within 13 resident programs; six joint programs in the Health-Related professions; and three programs at Kean/Ocean. The School offers programs in areas from Biological Sciences, Chemistry/Physics and the Pre health-related professions. Our graduates can be found working in industry, teaching in K-12 schools, practicing in healthcare facilities, or furthering their education at postgraduate levels.

Executive Director, Dr. Brian Teasdale
C-124 (908) 737-3654

ACADEMIC DEGREES, PROGRAMS

B.A. in Biology
General Option
Teacher Certification (P-12) Option
Teacher of Students with Disabilities (P-12) Option

B.S. in Biology
Environmental Biology Option
Cell and Molecular Biology Option

B.A. in Chemistry
General Option
Preprofessional Option
Teacher Certification (P-12) Option
Technical Sales and Marketing Option

B.S. in Chemistry
ACS Certified Chemical Instrumentation Option
ACS Certified Expanded Option

B.S. in Medical Technology
General Option
Cytotechnology Option
Histotechnology Option

B.S.N. in Nursing

JOINT (OR COMBINED) PROGRAMS

B.S. in Health Information Management
(with Rutgers University)

B.S. in Clinical Laboratory Science
Medical Laboratory Science
(with Rutgers University)

B.S. in Clinical Laboratory Science
Cytotechnology
(with Kean University Nathan Weiss Graduate College)

B.A. Earth Science/M.S.
Occupational
Therapy (with Kean University Nathan Weiss Graduate College)
B.S. in Health Information Management/
M.A. Communication Studies
(With Rutgers University)

MINOR PROGRAMS

Biology
Chemistry

DEPARTMENTS, FACULTY

Faculty: Bennett, Castiglione, Field, Fried, Gao (Physics Coordinator), James (Biology Coordinator and Health Information Management Coordinator), Koncny, LaFleur, Lees, Lorentzen, Mancarella, Mongelli, Morrow, Porta, Pu, Reilly, Shin (Chemistry Coordinator), Sprinkle, Stokes-Huby, Spaccarotella (Biology Coordinator), Teasdale (Executive Director), Vassiliou, Yang, Yu, Zarrilli, Zhang

Wenzhou, China: Meng, Ado

Health Information Management Liaison to Rutgers University: James

Medical Technology Coordinator: James

COURSE SCHEDULING FREQUENCIES

At the end of the course description is a code in parenthesis that indicates the frequency the course is offered to assist students in planning their registration.

Key:
E = Every Semester
FA = Every Fall
SP = Every Spring
FE = Fall, Even Years
SE = Spring, Even Years

BIOLOGY

Program Coordinator, Dr. Roxie James, Dr. Kim Spaccarotella
C-112 (908) 737-3648

The Biological Sciences Program offers a B.A. degree with three options, and a B.S. Biology Degree with a Cell & Molecular Option. A Minor in Biology is also available. The B.A. Biology Major must obtain a 2.5 grade point average (GPA) to be admitted into the Major and to graduate. The B.S. Biology option has a 3.0 GPA requirement.

The B.A. options are traditional liberal arts degrees that prepare students for teaching in elementary or secondary schools and for life science positions in industry or government. Additionally, there are B.A. tracks leading to graduate study in Occupational Therapy, Physical Therapy, and as a Physician Assistant.

The B.S. Biology Cell & Molecular option is a degree program in the biological sciences focused on students looking to pursue advanced graduate or professional degrees within the areas of biotechnology, molecular biology, biomedical research, microbiology, medicine, etc. The choice of whether to pursue a B.A. or B.S. in Biology should be done in consultation with a faculty advisor.

Kean University maintains articulation agreements with Rutgers University and the New York College of Podiatric Medicine. The former allows Kean students in the appropriate B.A. tracks to apply at Rutgers University (formerly UMDNJ) for admission to the Doctor of Physical Therapy or for the Master of Science Physician Assistant programs. B.A. biology majors who are interested in Podiatric Medicine may apply to the NY College of Podiatric Medicine for the Doctorate in Podiatric Medicine degree program.
Qualified students pursuing a B.A. degree in Biology also may apply to participate in the Biology Honors Program. Additional information about the Honors Program is provided below.

Each student majoring in Biology should consult with his/her departmental advisor to select the appropriate degree option, and major electives for his or her respective interests and goals.

For information regarding College/program mission and student learning outcomes please see http://www.kean.edu/KU/Natural-Sciences-Mission-and-SLOs

B.A. DEGREE BIOLOGY

OPTION: GENERAL

FOUNDATIONS REQUIREMENTS 13
GE 1000 Transition to Kean 1
ENG 1030 College Composition 3
MATH 1054 Precalculus 3
COMM 1402 Speech Communication as Critical Citizenship 3
GE 2024 Research and Technology 3

DISCIPLINARY/INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS 34-35

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

OR HIST 1062 Worlds of History 3
Select two courses from different areas:
Economics or Geography 3
Political Science 3
Psychology 3
Sociology or Anthropology 3
Interdisciplinary 3
Science & Mathematics
MATH 1016 Statistics 3
CHEM 1083 Chemistry I 4
CHEM 1084 Chemistry II 4
Health/Physical Education 2-3
ID 1225 Issues Contemp. Health
OR ID 1010 Leisure & Rec Multicult Soc 3
OR Physical Education 2

MAJOR/GE CAPSTONE 3
BIO 4970 Seminar in Integrative Biology 3

*Required Distribution Course

ADDITIONAL REQUIREMENTS 25
CHEM 2581 Organic Chemistry Lecture I 3
CHEM 2582 Organic Chemistry Lecture II 3
CHEM 2583 Organic Chemistry Lab I 2
CHEM 2584 Organic Chemistry Lab II 2
MATH 2415 Calculus I 4
ENV 1000 Introduction to Environ Sci 3
PHYS 2091 General Physics I 4
PHYS 2092 General Physics II 4

MAJOR REQUIREMENTS 31

REQUIRED COURSES IN BIOLOGY 24

BIO 1300 General Biology I 4
BIO 1400 General Biology II 4
BIO 2500 Principles of Botany 4
BIO 3400 Zoology: Form and Function 4
BIO 3614 Principles of Ecology 4
BIO 3709 Genetics 4

MAJOR ELECTIVES 8
Selected with departmental advisement at the 3000-4000 level.

FREE ELECTIVES 19-20
At least 50% must be at 3000-4000 level.

TOTAL 124

B.A. DEGREE BIOLOGY

OPTION: TEACHER CERTIFICATION

Students choosing this (P-12) option must make a formal application for admission to the Middle and Secondary Education (MSE) 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 72

GENERAL EDUCATION 48

FOUNDATIONS REQUIREMENTS 13
GE 1000 Transition to Kean 1
ENG 1030 College Composition 3
MATH 1000 College Algebra 3
COMM 1402 Speech Communication as Critical Citizenship 3
GE 2024 Research and Technology 3

DISCIPLINARY/INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS 35

Humanities 9

BIO 1300 General Biology I 4
BIO 1400 General Biology II 4
BIO 2500 Principles of Botany 4
BIO 3400 Zoology: Form and Function 4
BIO 3614 Principles of Ecology 4
BIO 3709 Genetics 4

MAJOR ELECTIVES 8
Selected with departmental advisement at the 3000-4000 level.

FREE ELECTIVES 19-20
At least 50% must be at 3000-4000 level.

TOTAL 124
*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

OR HIST 1062 Worlds of History 3
PSY 1000 General Psychology 3
SOC 1000 Introduction to Sociology 3

OR ANTH 1800 Cultural Anthropology 3
Science & Mathematics 11
*MATH 1054 Precalculus 3
CHEM 1083 Chemistry I 4
CHEM 1084 Chemistry II 4
Health/Physical Education 3
ID 1225 Issues Contemp. Health 3

MAJOR/GE CAPSTONE 3
BIO 4970 Seminar in Integrative Biology 3
*Required Distribution Course

ADDITIONAL REQUIREMENTS 25
MATH 2415 Calculus I 4
PHYS 2091 General Physics I 4
PHYS 2092 General Physics II 4
CHEM 2180 Prin. Organic Chemistry 4
PSY 2110 Psych. Adolescence 3
ES 1000 Observing the Earth 3

ID 2955 Disabled Person in American Society 3

MAJOR REQUIREMENTS 32

REQUIRED COURSES IN BIOLOGY 24
BIO 1300 General Biology I 4
BIO 1400 General Biology II 4
BIO 2500 Prin. of Botany 4
BIO 3400 Zoology: Form and Function 4
BIO 3614 Principles of Ecology 4
BIO 3709 Genetics 4

MAJOR ELECTIVES 8
Selected with departmental advisement at the 3000-4000 level.

PROFESSIONAL EDUCATION 30
Sophomore Level
EMSE 2801 Intro Field Exp K-12 3
Junior Level
EDUC 3000 Curriculum, Evaluation and Learner 3
EDUC 3401 Language Arts/Reading K-12 3
EMSE 3122 Computers in Education 3
EMSE 3230 Science Education K-12 3
EMSE 3801 Junior Field Experience K-12 2
EMSE 3903 Eng Language Learning in America 1
Senior Level
EMSE 4811 Professional Intern/Subj Area K-12 9

PROFESSIONAL/GE CAPSTONE
EDUC 4000 Teacher and Classroom 3

TOTAL 133

B.A. DEGREE BIOLOGY

OPTION: DUAL CERTIFICATION FOR TEACHERS OF STUDENTS WITH DISABILITIES AND P-12 BIOLOGY

Students who wish to be certified in both Biology P-12 and Educator of Students with Disabilities should consult the Catalogue under Special Education programs for information on admissions and grade requirements for this dual certification program. Students choosing this option must make a formal application for admission to the Department of Special Education. Prior to taking Special Education courses, all prerequisites must be met.

GENERAL EDUCATION AND ADDITIONAL LIBERAL ARTS REQUIREMENTS 68

GENERAL EDUCATION

FOUNDATIONS REQUIREMENTS 13
GE 1000 Transition to Kean 1
ENG 1030 College Composition 3
MATH 1000 College Algebra 3
COMM 1402 Speech Communication as Critical Citizenship 3
GE 2024 Research and Technology 3

DISCIPLINARY/INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS 32

Humanities 9
*ENG 2403 World Literature 3
Select two courses from different areas:
Fine Arts or Art History 3
Philosophy or Religion 3
Music or Theatre 3
Social Sciences 9
*HIST 1000 History of Civil Society in America 3
PSY 1000 General Psychology 3
SOC 1000 Introduction to Sociology 3

OR

ANTH 1800 Cultural Anthropology 3
Science & Mathematics 11
*MATH 1054 Precalculus 3
CHEM 1083 Chemistry I 4
CHEM 1084 Chemistry II 4
Health/Physical Education 3
ID 1225 Issues Contemp. Health 3
*Required Distribution Course

ADDITIONAL REQUIREMENTS 23
PSY 2110 Psychology of Adolescence 3
PHYS 2091 General Physics I 4
PHYS 2092 General Physics II 4
ES 1000 Observing the Earth 3
ID 2052 Human Exceptionality 3
ID 3051 Computer Technology in Today’s Inclusive Society 3
ID 3163 Building Inclusive Environments Through Positive Behavioral Supports 3

ACADEMIC MAJOR: 32 S.H. (OR MORE)
A minimum of 32 credits as a Bio Science major as outlined in the Kean University catalog. See Academic Advisor in that department for requirements. Note: No Major Capstone course required. All major courses require a grade of C or better.

REQUIRED COURSES:
BIO 1300 General Biology I 4
BIO 1400 General Biology II 4
BIO 2500 Prin. of Botany 4
BIO 3400 Zoology: Form and Function 4
BIO 3614 Principles of Ecology 4
BIO 3709 Genetics 4

MAJOR ELECTIVES 8
Selected with departmental advisement at the 3000-4000 level.

PROFESSIONAL EDUCATION 32
Sophomore Level
SPED 2120 Introductory Field Experience in Special Education 3
SPED 2200 The Multicultural Learner in Diverse Settings 3
Junior Level
EDUC 3000 Curriculum, Evaluation and Learner 3
SPED 3000 Principles and Practices for the Contemporary Educator (WE) 3
SPED 3001 Preprofessional Field Experience for Educators Across Settings 2
EMSE 3230 Science Education K-12 3
EDUC 3401 Language Arts/Reading, K-12 3
Senior Level
EDUC 4000 Teacher and Classroom 3
SPED 4135 Special Education Student Teaching 9
(EDUC 4000 must be taken concurrently)

TOTAL 132

B.S. DEGREE BIOLOGY

OPTION: CELL AND MOLECULAR BIOLOGY

GENERAL EDUCATION 35
FOUNDATIONS REQUIREMENTS 13
GE 1000 Transition to Kean 1
ENG 1030 College Composition 3
MATH 1000 College Algebra 3
COMM 1402 Speech Communication as Critical Citizenship 3
GE 2024 Research and Technology 3

DISCIPLINARY/INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS 22
Humanities 6
*ENG 2403 World Literature 3
Select one course from below:
Fine Arts or Art History 3
Philosophy or Religion 3
Foreign Languages 3
Music or Theatre 3
Interdisciplinary 3
Social Sciences 6
*HIST 1000 History of Civil Society in America

OR HIST 1602 Worlds of History 3
Select one course from below:
Economics or Geography 3
Political Science 3
Psychology 3
Sociology or Anthropology 3
Interdisciplinary 3

Science & Mathematics 7
*MATH 1054 Precalculus 3
CHEM 1083 Chemistry I 4

MAJOR/GE CAPSTONE 3
BIO 4970 Seminar in Integrative Biology 3

*Required Distribution Course

ADDITIONAL REQUIREMENTS 25
CHEM 1084 Chemistry II 4
CHEM 2581 Organic Chemistry Lecture I 3
CHEM 2582 Organic Chemistry Lecture II 3
CHEM 2583 Organic Chemistry Lab I 2
CHEM 2584 Organic Chemistry Lab II 2
MATH 2411 Calculus I 3
PHYS 2091 General Physics I 4
PHYS 2092 General Physics II 4

MAJOR REQUIREMENTS 48-50

REQUIRED COURSES IN BIOLOGY 34
BIOS 1200 Introduction to Biology 4
BIOS 2201 General Biology: Diversity and Interactions 4
BIOS 2202 General Biology: Molecular and Cellular Processes 4
BIO 3305 Principles of Microbiology 4
BIO 3704 Principles of Genetics 3
BIO 3705 Principles of Genetics Lab 2
BIO 4105 Essentials of Biochemistry 4
BIO 4225 Cell Physiology 4
BIOS 4704 Molecular Biology of Genes 3

PROGRAM RELATED ELECTIVES 16-18
BIO 3303 Anatomy and Physiology 4
BIO 3304 Anatomy and Physiology 4
BIO 3815 Microtechniques 4
BIO 3820 Basic Tissue Culture 4
BIOS 4310 Virology 4
BIOS 4455 Immunology
BIOS 4455 Developmental Biology
BIOS 4575 Plant Physiology
Other courses may be chosen with departmental advisement

FREE ELECTIVES
At least 50% must be at the 3000-4000 level.

TOTAL 124

MINOR IN BIOLOGY
One semester of general chemistry and the following:

REQUIRED COURSES
8
Bio 1300 General Biology I
Bio 1400 General Biology II

ELECTIVES
10
Ten credits in biology, including at least 7 credits at the 3000-4000 level, selected with approval of a departmental advisor.

HONORS PROGRAM IN BIOLOGY
Sophomores and juniors in the B.A. Biology options may participate in this Honors Program. To qualify, they must have a minimum 3.5 grade point average and have completed, respectively, at least 8 or 12 credits in biology. Once accepted into the Honors Program, students enroll in BIO 4901 (Honors Thesis in Biology I) followed by BIO 4902 (Honors Thesis in Biology II) carrying out a laboratory or field research project under the supervision of a faculty member of the Department of Biological Sciences. Upon completion of the research, each student prepares a written thesis and makes public presentations of his or her findings. Successful participation in the Honors Program will be indicated on the student's co-curricular transcript.

BIOLOGY COURSES

GENERAL
Bio 1000 Principles of Biology
An introduction to the structure and function of living cells and organisms and their interdependencies and adaptations to the environment. This course is not required for Biology majors. (3 hr. lec./3 hr. lab.) (E)

Prerequisites: Completion of all GELAP foundation courses in Math, English and Communication Sciences. Approved General Education Distribution Course.

Bio 1200 Biology & Society
Explores the impact of biological discoveries and their applications on individuals and society. Includes ethical and practical ramifications. May not be used for major credits toward graduation by biology majors. Satisfies the general education disciplinary/interdisciplinary science requirement. (FO)
Prerequisites: COMM 1402 and GE 2020 or GE 2021 or GE 2022 or GE 2023 or GE 2024)

Bio 3000 Marine Biology
The interrelations of marine plants and animals with their environment. Topics include: primary production, symbiosis, predation, energy flow, and zonation. Effects of salinity, temperature, light, dissolved oxygen, tides and wave action studied. One weekend field trip required. (3 hr. lec./3 hr. lab.) Equivalent given summers at N.J. Marine Sciences Consortium field stations. (SE)
Prerequisites: CHEM 1084 or equivalent; eight credits in biology or permission of instructor.

BIOCHEMISTRY
Bio 4105 Essentials of Biochemistry
An introduction to the chemistry of biologically important compounds and their relationship to the metabolic activity of living cells. Laboratory activities will utilize the methods and techniques currently used in biochemical research. (3 hr. lec./3hr. lab.) (E)
Prerequisites: One semester of Organic Chemistry, BIO 1400, or permission of instructor.
Writing Emphasis Course.

CELLULAR
Bio 1300 General Biology I: Cell Biology
An introduction to the fundamental concepts of biological organization, with emphasis on the molecular and cellular levels. Emphasis on scientific methods, the integration of structure and function at the cellular level, and on the underlying biochemistry. This course, in combination with BIO 1400, forms the foundation for Biology majors and for students following the Science Core (3hr.LEC/3 hr.Lab). This course is not a General Education Lab course. (E)
Pre-requisites: Math 1000 or placement. Corequisite: Math 1054
Replaces BIO 2200
Equivalents: BIO 2200, BIOS 2201, SELS 2201

Bio 2200 Cell Biology
An introduction to the fundamental concepts of biological organization, with emphasis on the molecular and cellular levels. Emphasis is placed on scientific methods, the integration of structure and function at the cellular level, and on the underlying biochemistry. This course, in combination with BIO 2400, forms the foundation for the biology major. (3 hr. lec./3 hr. lab.)
Co-requisite: CHEM 1083
Equivalents: BIO 1300, BIOS 2201, SELS 2201

Bio 3260 Introduction to Histology
A laboratory oriented course dealing with the microscopic and ultrastructural anatomy of mammalian tissues and organs, with emphasis on relating structure to function. (3 hr. lec./3 hr. lab.)
Prerequisites: 12 credits in biology including BIO 1300 and BIO 1400, or permission of instructor.

Bio 4225 Cell Physiology
Biochemical and electron micrographic studies of mammalian tissue subcellular organization by separation and analysis of cell molecules and organelles, and determination of their structure and function. (3 hr. lec/3hr.lab.) (E)
Prerequisites: BIO 1400 and CHEM 2180 or CHEM 2581 or permission of instructor.

MICROBIOLOGY
Bio 3305 Principles of Microbiology
A study of microorganisms with emphasis on bacteria. Morphology, physiology and metabolism, ecology, taxonomy and methods of culture and identification of some common microorganisms. (3 hr. lec/3 hr. lab.) (E)
Prerequisite: BIO 1400 or permission of instructor.

Bio 4310 Virology
Study of the isolation, propagation, and characteristics of viruses, and the techniques for achieving those goals. Consideration also given to the interaction of viruses with prokaryotic and eukaryotic cells, the origin and evolution of viruses, and the emergence of new viruses.
Prerequisites: BIO 1400, BIO 3305 and CHEM 2180, and permission of instructor.

Bio 4315 Immunology
A fundamental study of the innate and adaptive immune systems of animals. Consideration also given to immunologic responses of plants. (3 hr. lec/3 hr. lab.) (E)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 2400</td>
<td>General Biology II: Evolution, Biodiversity and</td>
<td>Biology majors and for students following the Science Core. (3hr.lect/3hr.lab)</td>
</tr>
<tr>
<td></td>
<td>Ecology</td>
<td>This course is not a General Education Lab course. (E)</td>
</tr>
<tr>
<td>BIO 2400</td>
<td>Genes, Organisms, Populations</td>
<td>Pre-requisite: BIO 1300 Corequisite: Chem 1083</td>
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<tr>
<td></td>
<td></td>
<td>Replaces BIO2400</td>
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<tr>
<td></td>
<td></td>
<td>Equivalents: BIO 2400, BIOS 2202, SELS 2202</td>
</tr>
<tr>
<td>BIO 2402</td>
<td>Human Physiology and Anatomy</td>
<td>Pre-requisite: BIO 1400 or BIO 2400 and CHEM 1084. or permission of instructor.</td>
</tr>
<tr>
<td>BIO 2404</td>
<td>Zoology: Form and Function</td>
<td>Pre-requisites: BIO 2400 and CHEM 1084, or permission of instructor.</td>
</tr>
<tr>
<td>BIO 2405</td>
<td>Basic Gross Anatomy</td>
<td>Pre-requisite: BIO 1000 or permission of instructor. Approved General Education Distribution Course</td>
</tr>
<tr>
<td>BIO 2406</td>
<td>Neuroscience</td>
<td>Pre-requisite: BIO 1300 or permission of instructor.</td>
</tr>
<tr>
<td>BIO 3420</td>
<td>Parasitology</td>
<td>Introduction to animal parasites and parasitism; emphasis on morphology, distribution, life cycles and effects on host of protozoan, helminth and arthropod parasites. (3 hr. lect./3 hr. lab.)</td>
</tr>
<tr>
<td>BIO 3433-3434</td>
<td>Anatomy and Physiology I and II (Honors)</td>
<td>Designed for preprofessional students in biology and medical technology. These Honors courses integrate gross and microscopic structure of the human body systems with their function at a more intensive level than BIO 3403-3404. Laboratories are synchronized with lecture-discussion materials and include studies with microscopic and macroscopic materials, prosected models, animal specimens and computer simulations.</td>
</tr>
<tr>
<td>BIO 3433</td>
<td>Anatomy and Physiology I and II</td>
<td>Pre-requisite: BIO 1400 or BIO 2400 and CHEM 1084, or permission of instructor.</td>
</tr>
<tr>
<td>BIO 3434</td>
<td>Anatomy and Physiology I and II</td>
<td>Pre-requisites: BIO 1400 or BIO 2400 and CHEM 1084, or permission of instructor.</td>
</tr>
<tr>
<td>BIO 3450</td>
<td>Biological Aspects of Aging</td>
<td>A study of the biology of aging from biochemical, cellular, and physiological aspects of aging.</td>
</tr>
</tbody>
</table>
viewpoints. Emphasis on age-associated functional and structural changes of the
organ systems. (E)
Prerequisite: BIO 1300 or BIO 2200 or permission of instructor.

BIO 4455 Developmental Biology
(4)
A study of developmental processes in animals combining descriptive, theoretical and experimental approaches. Includes study of cell determination and pattern formation. (3 hr. lec./3 hr. lab.)
Prerequisites: BIO 3709 or BIO 4105 or permission of instructor.

ORGANISMS-PLANTS

BIO 2500 Principles of Botany
(4)
Structure, function, development, reproduction, and evolution of plants. (3 hr. lec./3 hr. lab.)
Prerequisite: BIO 1300 or BIO 2200 or equivalent or permission of instructor.

BIO 3513 Morphology and Evolution of the Plant Kingdom
(4)
A study of the structural, reproductive, and evolutionary aspects of the plant kingdom. (3 hr. lec./3 hr. lab.)
Prerequisite: BIO 2500 or permission of instructor.

BIO 3535 Field Botany
(3)
Principles of field identification of local flora with emphasis on use and construction of keys. Two all day Saturday field trips. (E) (Kean Ocean)
Prerequisite: BIO 2500 or permission of instructor.

BIO 4575 Plant Physiology
(4)
A study of physiological mechanisms involved in the germination, growth, development and reproduction of green plants, including water relations, carbohydrate metabolism, translocation, photosynthesis, mineral nutrition, growth regulators, and growth and development. (3 hr. lec./3 hr. lab.)
Prerequisites: BIO 1400 or BIO 2400 and BIO 2500.

ECOLOGY

BIO 2601, 2602 Environment, Ecology, and Humanity
(4/3)
A course for non-science majors briefly describing basic global ecological principles. Emphasis on disruptive effects on the environment. Pollution, pesticides, endangered species and human population pressures. This course may be taken with laboratory for 4 s.h. or without laboratory for 3 s.h. Biology majors may not receive credit for this course.

Prerequisite: BIO 1000 or permission of instructor.

BIO 3614 Principles of Ecology
(4)
Factors affecting the distribution and abundance of organisms. Basic ecology is examined at the organismal, population and ecosystem levels. Human impact on the environment. (3 hr. lec./5 hr. lab.)
Prerequisite: BIO 1300 or permission of instructor. Writing Emphasis Course

BIO 4615 Applied Ecology
(4)
Examination of environmental problems, solutions and management dealt with by biologists in government and industry. Wildlife management, conservation biology and industrial ecology. Student must provide own transportation for some labs. (3 hr. lec./3 hr. lab.)
Prerequisite: BIO 3614 or equivalent.

GENETICS

BIO 3709 Genetics
(4)
A study of the essential concepts, principles and applications of all branches of genetics, including transmission, molecular and population genetics. Discussion of recent developments in the field, focusing on genomics and new genetic techniques. Examinations of principles and application of genetics by means of laboratory exercises. (3 months lecture, 3 hours lab.)
Prerequisites: BIO 1400 or permission of instructor.

BIO 4700 Molecular Genetics
(4)
Molecular biology of the gene with an emphasis on current topics related to recombinant DNA and genetic engineering. Laboratory activities include methods and instrumentation used in recombinant DNA studies. (3 hr. lec./3 hr. lab.)
Prerequisites: BIO 3709 and BIO 4105 or permission of the instructor.

BIO 4704 Molecular Biology of Genes
(3)
Molecular biology of genetic inheritance and molecular evolutionary genetics, with an emphasis on recent advances. Topics include DNA and chromatin structure and function, regulation of gene expression and related processes, mutation, gene duplication, patterns of genetic divergence and genealogical reconstruction. (3 hr. lec.)
Prerequisites: BIO 3709 and one semester of Organic Chemistry, or permission of the instructor.

TECHNIQUES

BIO 3815 Microtechniques
(4)
Experience in the preparation of biological material for microscopic examination; fixation, embedding, sectioning, mounting, staining; preparation of whole mounts of small specimens. (Two 3 hr. lec./lab. periods; many procedures require the student's presence at times in addition to scheduled class hours.)
Prerequisites: One of the following: BIO 1400, 2402, 2409, 3403 or 3433, CHEM 1032 or 1084; or permission of instructor.

BIO 3820 Basic Tissue Culture
(4)
Fundamentals of animal and plant tissue culture. Laboratory exercises include methods of establishing and maintaining primary tissue cultures and the culture of established cell lines. (3 hr. lec./3 hr. lab.)
Prerequisites: 16 credits of Biology including BIO 1400 or permission of the instructor.

BIO 4835 Biostatistics
(3)
Basic statistical techniques useful in biological research including frequency distributions, statistical inference, and application of chi square, analysis of variance and regression. (E)
Prerequisites: 16 credits in Biology including BIO 1300 and BIO 1400, and MATH 1054, or permission of instructor.

RESEARCH, SEMINAR, EXTERNSHIPS

BIO 4395, 6, 7, 8 Cooperative Education in Biology
(1-4)
Off-campus laboratory experience in a biological field. Students may work full or part-time by arrangement with employer. May be repeated for credit, up to a total of four credits. (E)
Prerequisites: Completion of 16 credits in Biology Core and Junior Status, and permission of department chairperson.

BIO 4901, 4902 Honors Thesis in Biology I and II
(3, 3)
Qualified undergraduate biology majors will gain an appreciation of how biological knowledge is acquired by participating in an independent laboratory or field research project under the guidance of a faculty member, to a depth not attainable through regular class work. Both courses are taken as a chronological series, (BIO 4901 must precede BIO 4902). (E)
Prerequisites: Open to students who have fulfilled 20 BIO credit hours, have been admitted into the Biology Honors Program, and have permission of Honors faculty advisor.

BIO 4911, 2, 3, 4 Special Topics in Biology
(1-4)
Class work designed to provide an opportunity to study special topics in biology which are not studied in regular
courses. Topics to be announced by the department. One semester hour of credit given for each 15 hours of class work. (E)

Prerequisite: 16 semester hours of biology.

BIO 4961,2,3 Independent Research in Biology
(1-3)
A laboratory or field investigation of a biology research problem, performed independently by student, under the supervision of a faculty member. May be repeated for credit, up to a total of six credits; however, only four credits may be used to fulfill major elective requirement. (E)

Prerequisite: Open to seniors with a minimum of 20 credits in Biology, or Juniors who are on Dean’s List at the time of enrollment with a minimum of 16 credits in Biology, and permission of department chairperson.

BIO 4970 Seminar in Integrative Biology
(3)
Critical analysis of current topics in biology utilizing the primary literature and integrating concepts taught in the Biology Core curriculum. Consideration given to social, ethical, philosophical and/or historical aspects of the life sciences. Format includes student presentations, reading-based class discussions, and library papers. (E)

Prerequisites: 20 credits in Biology Core and Senior status.

NEW JERSEY MARINE SCIENCES CONSORTIUM
Kean University is a participating member institution of the New Jersey Marine Sciences Consortium (NJMSC) which is dedicated to promoting knowledge about and the stewardship of New Jersey's marine and coastal environment. Kean University students may enroll in credit-bearing marine science courses which are taught on a rotating basis at the Sandy Hook field station. Students are referred to the NJMSC website at http://www.njmsc.org to determine which courses are being offered each summer. Sample course offerings include the following:

BIO 2650 Introduction to Marine Biology
(4)
Offered (some) summers at N.J. Marine Sciences Consortium field stations. A field and laboratory oriented course covering the characteristics of marine plants and animals; instruction and experience in collecting and identifying examples of local marine flora and fauna. May not be applied toward credit for major requirements in biology. (E)

Prerequisite: BIO 1000 or equivalent.

BIO 4415 Ichthyology
(4)
Offered (some) summers at N.J. Marine Sciences Consortium field stations. The biology of the major groups of fishes, including fish systematics, anatomy, physiology, reproduction, evolution, adaptations, genetics, ecology and zoogeography. (E)

Prerequisite: BIO 3400.

SONS Chemistry
Program Coordinator, Dr. Yeung-gyo Shin
C-221 (908) 737-3680
The Department of Chemistry recognizes its obligation to guide its students to think analytically, critically and creatively. Chemistry is a discipline that combines qualitative and quantitative reasoning. These discipline-based courses develop reasoning skills, which are required for solving scientific problems and for understanding current structural and behavioral models of matter.

The Department is committed to offering major programs for those students wishing to concentrate their undergraduate studies in the field of chemistry. A program certified by the Committee on Professional Training of the American Chemical Society (ACS) is offered for those students wishing to undertake graduate study in chemistry or who wish to seek employment as chemists upon graduation. The department also offers a major program for students seeking entry into new and current technologies and to develop research skills through our undergraduate research program.

For information regarding College/program mission and student learning outcomes please see http://www.kean.edu/KU/Natural-Sciences-Mission-and-SLOs

B.A. DEGREE - CHEMISTRY

OPTION: GENERAL
This program is designed to prepare the student for graduate study in the various fields of chemistry and for positions in the chemical and related industries.

GENERAL EDUCATION REQUIREMENTS
44-45

FOUNDATIONS REQUIREMENTS1
13
GE 1000 Transition to Kean2
1
ENG 1030 College Composition3
3
MATH 1000 Algebra for College Students4
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
Foreign Languages5
3
(Must take I and II for credit)
Philosophy or Religion
3
Music or Theatre
3
Interdisciplinary
3

SOCIAL SCIENCES
9
*HIST 1000 History of Civil Society in America

OR HIST 1062 Worlds of History
3
Select two courses from different areas:
Economics or Geography
3
Political Science
3
Psychology
3
Sociology or Anthropology
3
Interdisciplinary
3

SCIENCE & MATHEMATICS
11
*MATH 1054 Precalculus6
3

PHYS 2095 Physics I
4
PHYS 2096 Physics II
4

HEALTH/PHYSICAL EDUCATION
2-3
ID 1010 Leisure & Rec in Multicultural Society

OR
ID 1225 Issues Contemp. Health
3
OR
**Physical Education**  
2

**ADDITIONAL REQUIREMENTS**  
19  
MATH 2415 Calculus I  
4  
MATH 2416 Calculus II  
4  
MATH 3415 Calculus III  
4  
ENV 1000 Intro to Environmental Science  
3  
PHYS 2097 Physics III  
4

**MAJOR AND CAPSTONE REQUIREMENTS**  
45  
CHEM 1083 Chemistry I  
4  
CHEM 1084 Chemistry II  
4  
CHEM 2283 Quantitative Analysis  
4  
CHEM 2491 Inorganic Chemistry  
3  
CHEM 2581 Organic Chemistry Lec I  
3  
CHEM 2582 Organic Chemistry Lec II  
3  
CHEM 2583 Org. Chemistry Lab & Rec I (WE)  
2  
CHEM 2584 Org. Chemistry Lab & Rec II  
2  
CHEM 3284 Instr Meth of Analysis (WE)  
4  
CHEM 3381 Physical Chemistry Lec I  
3  
CHEM 3382 Physical Chemistry Lec II  
3  
CHEM 3383 Physical Chemistry Lab I  
2  
CHEM 3384 Physical Chemistry Lab II  
2  
CHEM 4481 Advanced Inorganic Chemistry  
3

**MAJOR/GE CAPSTONE COURSE**  
CHEM 4908 Seminar in Chemistry  
3

**FREE ELECTIVES**  
15-16  
(50% of free electives must be taken at the 3000-4000 level)

**TOTAL**  
124  
1 GE required course  
1 See prerequisites and equivalencies.  
2 Required of all Freshmen and Transfers with fewer than 10 credits.  
3 ENG 1030, all Major courses, and the Capstone require a grade of C or better.  
4 Students whose qualifying score on the placement test makes them eligible to take MATH 1054 or MATH 2415 may take that course instead. In that case, MATH 1054 or MATH 2415 will count as the General Education requirement and the student may take another 3 or 6 credits in Free Electives to total 124 S.H.  
5 Credit granted upon completion of elementary or intermediate foreign language. Three credits can be applied to Humanities and 3 credits can be applied to Free Electives.

**B.A. DEGREE - CHEMISTRY**

**OPTION: PREPROFESSIONAL**

The following program is designed for students planning to apply to medical or dental schools. Since many medical schools prefer a core of courses in the humanities, students are advised to consult the catalogs of medical schools to which they will apply and to select courses with departmental advisement which will insure meeting entrance requirements.

**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:  
3

Fine Arts or Art History  
3  
Philosophy or Religion  
3  
Foreign Languages  
3  
(Must take I and II for credit)  
Music or Theatre  
3  
Interdisciplinary  
3

**SOCIAL SCIENCES**  
9  
*HIST 1000 History of Civil Society in America

**OR**  
HIST 1062 Worlds of History  
3  
Select two courses from different areas:  
Economics or Geography  
3  
Political Science  
3  
Psychology  
3  
Sociology or Anthropology  
3  
Interdisciplinary  
3

**SCIENCE & MATHEMATICS**  
11  
*MATH 1054 Precalculus  
3  
PHYS 2095 Physics I  
4  
PHYS 2096 Physics II  
4

**HEALTH/PHYSICAL EDUCATION**  
2-3  
ID 1010 Leisure & Rec in Multicultural Society

**OR**  
ID 1225 Issues Contemp. Health  
3  
Physical Education  
2

**ADDITIONAL REQUIREMENTS**  
27  
MATH 2415 Calculus I  
4  
MATH 2416 Calculus II  
4  
MATH 3415 Calculus III  
4  
PHYS 2097 Physics III  
4  
BIO 1300 General Biology I  
4  
BIO 1301 General Biology II  
4  
CHEM 2281 Inorganic Chemistry  
3  
CHEM 2282 Organic Chemistry Lec I  
3  
CHEM 2283 Physical Chemistry Lec I  
3  
CHEM 2284 Physical Chemistry Lec II  
3  
CHEM 2285 Physical Chemistry Lab I  
2  
CHEM 2286 Physical Chemistry Lab II  
2  
CHEM 2491 Physical Chemistry Lab III  
2  
CHEM 2492 Physical Chemistry Lab IV  
2  
CHEM 4481 Advanced Inorganic Chemistry  
3  
CHEM 4482 Advanced Organic Chemistry  
3  
CHEM 4483 Advanced Physical Chemistry  
3  
CHEM 4484 Advanced Inorganic Chemistry  
3  
CHEM 4485 Advanced Organic Chemistry  
3  
CHEM 4486 Advanced Physical Chemistry  
3  
CHEM 4487 Advanced Inorganic Chemistry  
3  
CHEM 4488 Advanced Organic Chemistry  
3  
CHEM 4489 Advanced Physical Chemistry  
3

*GE required course  
1 See prerequisites and equivalencies.  
2 Required of all Freshmen and Transfers with fewer than 10 credits.  
3 ENG 1030, all Major courses, and the Capstone require a grade of C or better.  
4 Students whose qualifying score on the placement test makes them eligible to take MATH 1054 or MATH 2415 may take that course instead. In that case, MATH 1054 or MATH 2415 will count as the General Education requirement and the student may take another 3 or 6 credits in Free Electives to total 124 S.H.  
5 Credit granted upon completion of elementary or intermediate foreign language. Three credits can be applied to Humanities and 3 credits can be applied to Free Electives.
MAJOR AND CAPSTONE REQUIREMENTS
35
CHEM 1083 Chemistry I 4
CHEM 1084 Chemistry II 4
CHEM 2283 Quantitative Analysis 4
CHEM 2581 Organic Chemistry Lec I 3
CHEM 2582 Organic Chemistry Lec II 3
CHEM 2583 Org. Chemistry Lab and Rec I (WE) 2
CHEM 2584 Org. Chemistry Lab and Rec II 2
CHEM 3284 Instr Meth of Analysis (WE) 4
CHEM 3381 Physical Chemistry Lec I 3
CHEM 3581 Biochemistry 3

FREE ELECTIVES
17-18
(50% of free electives must be taken at the 3000-4000 level).

TOTAL 124

* GE required course
1 See prerequisites and equivalencies.
2 Required of all Freshmen and Transfers with fewer than 10 credits.
3 ENG 1030, all Major courses, and the Capstone require a grade of C or better.
4 Students whose qualifying score on the placement test makes them eligible to take MATH 1054 or MATH 2415 may take that course instead. In that case, MATH 1054 or MATH 2415 will count as the General Education requirement and the student may take another 3 or 6 credits in Free Electives to total 124 S.H.
5 Credit granted upon completion of elementary or intermediate foreign language. Three credits can be applied to Humanities and 3 credits can be applied to Free Electives.

B.A. DEGREE - CHEMISTRY

OPTION: TECHNICAL SALES AND MARKETING OPTION
Keen University is currently not offering the Technical Sales and Marketing option to newly admitted students.
This program is designed to prepare students for employment at the interface between sales and marketing, and research and development. The curriculum is an amalgamation of courses from science and mathematics with those from business. Students should choose this option if they want the scientific background of a major in chemistry, but have career goals related to the sale and marketing of technical products or services.

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 4
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
Foreign Languages 3
3 (Must take I and II for credit)
Philosophy or Religion
3
Music or Theatre
3
Interdisciplinary
3

SOCIAL SCIENCES
9
*HIST 1000 History of Civil Society in America

OR HIST 1062 Worlds of History 3
Select two courses from different areas:
Economics or Geography
3
Political Science
3
Psychology
3
Sociology or Anthropology
3
Interdisciplinary
3

SCIENCE & MATHEMATICS
11
*MATH 1054 Precalculus 4
3
PHYS 2091 General Physics I 4
PHYS 2092 General Physics II 4

HEALTH/PHYSICAL EDUCATION
2-3
ID 1010 Leisure & Rec in Multicultural Society
3

OR
Physical Education
2

ADDITIONAL REQUIREMENTS
36
MATH 2415 Calculus I 4
BIO 1300 General Biology I 4
BIO 1400 General Biology II 4
COMM 3590 Business & Professional Presentation
3
ECO 2120 Business Statistics
3
MGS 2030 Principles of Management
3
MKT 2500 Principles of Marketing
3
MKT 3430 Advertising & Marketing Communication
3
MKT 3510 Consumer Behavior
3

(SELECT TWO MKT COURSES FROM BELOW)
MKT 4230 Advertising Campaigns
3
MAJOR AND CAPSTONE REQUIREMENTS

37

CHEM 1083 Chemistry I 4
CHEM 1084 Chemistry II 4
CHEM 2283 Quantitative Analysis 4
CHEM 2491 Inorganic Chemistry 3
CHEM 2581 Organic Chemistry Lec I 3
CHEM 2582 Organic Chemistry Lec II 3
CHEM 2583 Org. Chemistry Lab & Rec I (WE) 2
CHEM 2584 Org. Chemistry Lab & Rec II 2
CHEM 3284 Instr Meth of Analysis (WE) 4
CHEM 3581 Biochemistry 3
CHEM 3901 Independent Chem Res I 2

MAJOR/GE CAPSTONE COURSE³
CHEM 4908 Seminar in Chemistry 3

FREE ELECTIVES
6-7
(50% of free electives must be taken at the 3000-4000 level)

TOTAL
124

* GE required course
1 See prerequisites and equivalencies.
2 Required of all Freshmen and Transfers with fewer than 10 credits.
3 ENG 1030, all Major courses, and the Capstone require a grade of C or better.
4 Students whose qualifying score on the placement test makes them eligible to take MATH 1054 or MATH 2415 may take that course instead. In that case, MATH 1054 or MATH 2415 will count as the General Education requirement and the student may take another 3 or 6 credits in Free Electives to total 124 S.H.
5 Credit granted upon completion of elementary or intermediate foreign language. Three credits can be applied to Humanities and 3 credits can be applied to Free Electives.
6 Students are advised to fulfill 3 credits of free electives with ECO 1021 Principles of Economics.
7 To be used for initial construction of the Simulated Project Development and taken to one credit each in the Fall and Spring of the Junior year.

B.A. DEGREE - CHEMISTRY

OPTION: CHEMISTRY TEACHER CERTIFICATION

Students choosing this (P-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 REQUIREMENTS

45

FOUNDATION REQUIREMENTS¹

13

GE 1000 Transition to Kean² 1
ENG 1030 College Composition³ 3
MATH 1000 Algebra for College Students⁴ 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 Languages⁵ 3
(Must take I and II for credit)
Music or Theatre 3

SOCIAL SCIENCES 9
*HIST 1000 History of Civil Society in America 3
OR HIST 1062 Worlds of History 3
PSY 1000 General Psychology 3
SOC 1000 Intro to Sociology 3

OR
ANTH 1800 Cultural Anthropology 3

SCIENCE & MATHEMATICS 11
*MATH 1054 Precalculus⁴ 3
PHYS 2095 Physics I 4
PHYS 2096 Physics II 4

HEALTH/PHYSICAL EDUCATION 3
ID 1225 Issues Contemp. Health 3

ADDITIONAL REQUIREMENTS 26
MATH 2415 Calculus I⁴ 4
MATH 2416 Calculus II 4
PHYS 2097 Physics III 4
PSY 2110 Psy of Adolescence 3
BIO 1300 General Biology I 4
ID 2955 Disabled Pers in Amer Soc 3

Select one of the following courses:
GEOL 1200 Intro Geology 4
OR
METR 1300 Intro Meteorology 4
OR
ASTR 1000 Intro Astronomy 4
OR
OCEN 2400 Intro Oceanography 4

MAJOR AND CAPSTONE REQUIREMENTS

36

CHEM 1083 Chemistry I 4
CHEM 1084 Chemistry II 4
CHEM 2283 Quantitative Analysis 4
CHEM 2581 Organic Chemistry Lec I 3
CHEM 2582 Organic Chemistry Lec II 3
CHEM 2583 Org. Chemistry Lab & Rec I (WE) 2
CHEM 2584 Org. Chemistry Lab & Rec II 2
CHEM 3284 Instr. Methods of Analysis (WE) 4
CHEM 3381 Physical Chemistry Lec I 3
CHEM 3581 Biochemistry 3
CHEM 3901 Independent Chemistry Research I 1

MAJOR/GE CAPSTONE COURSE
CHEM 4908 Seminar in Chemistry 3

PROFESSIONAL EDUCATION
27
Sophomore Level
EMSE 2801 Intro Field Experience K-12 3

Junior Level
EDUC 3000 Curriculum Eval. & Learner 3
EDUC 3401 Language Arts/Reading K-12 3
EMSE 3230 Science Education K-12 3
EMSE 3801 Field Exp Subj Area K-12 3
EMSE 3903 Eng Lang Learn in Amer Soc 1

Senior Level
EMSE 4811 Prof Intern/Subj Area K-12 9

PROFESSIONAL/GE CAPSTONE
EDUC 4000 Teacher and Classroom 3

TOTAL 134

* GE required course
1 See prerequisites and equivalencies.
2 Required of all Freshmen and Transfers with fewer than 10 credits.
3 For Chemistry major, ENG 1030, all Major courses, and the Capstone require a grade of C or better. See Secondary Education for additional minimum grade requirements.
4 Students whose qualifying score on the placement test makes them eligible to take MATH 1054 or MATH 2415 may take that course instead. In that case, MATH 1054 or MATH 2415 will count as the General Education requirement and the student may take another 3 or 6 credits in Free Elective to total 134 S.H.
5 Credit granted upon completion of elementary or intermediate foreign language.

B.S. DEGREE - CHEMISTRY

OPTION: EXPANDED (ACS CERTIFIED)

For students who plan to enter professional careers in analytical chemistry immediately after graduation or who plan to undertake graduate study, the American Chemical Society (ACS) requires a curriculum for professional training that includes a series of advanced courses. The curriculum for this option is based upon the ACS guidelines. Students completing this program are certified by the ACS and may become members of the ACS immediately upon graduation. Students desiring to complete the expanded option should consult the program coordinator.

GENERAL EDUCATION REQUIREMENTS 32

FOUNDATION REQUIREMENTS 13
GE 1000 Transition to Kean 1
ENG 1030 College Composition 3
MATH 1000 Algebra for College Students 4
COMM 1402 Speech Communication as Critical Citizenship 3
GE 2024 Research & Technology 3

DISCIPLINARY & INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS

HUMANITIES 6
*ENG 2403 World Literature 3

Select one course from below:
Fine Arts or Art History 3

Science & Mathematics 4

SOCIAL SCIENCES 6

*HIST 1000 History of Civil Society in America

OR HIST 1062 Worlds of History 3

Select one course from below:
Economics or Geography 3
Political Science 3
Psychology 3
Sociology or Anthropology 3
Interdisciplinary 3

ADDITIONAL REQUIREMENTS 20
MATH 2415 Calculus I 4
MATH 2416 Calculus II 4
MATH 3415 Calculus III 4
PHYS 2096 Physics II 4
PHYS 2097 Physics III 4

MAJOR AND CAPSTONE REQUIREMENTS 57
CHEM 1083 Chemistry I 4
CHEM 1084 Chemistry II 4
CHEM 2283 Quantitative Analysis 4
CHEM 2491 Inorganic Chemistry 3
CHEM 2581 Organic Chemistry Lec I 3
CHEM 2582 Organic Chemistry Lec II 3
CHEM 2583 Organic Chemistry Lab/Rec I (WE)  
2
CHEM 2584 Organic Chemistry Lab/Rec II  
2
CHEM 3284 Instr. Methods of Analysis (WE)  
4
CHEM 3381 Physical Chemistry Lec I  
3
CHEM 3382 Physical Chemistry Lec II  
3
CHEM 3383 Physical Chemistry Lab I  
2
CHEM 3384 Physical Chemistry Lab II  
2
CHEM 3581 Biochemistry  
3
CHEM 4481 Adv. Inorganic Chemistry  
3
CHEM 4483 Inorganic Chemistry Lab  
3

MAJOR/GE CAPSTONE COURSE
CHEM 4908 Seminar in Chemistry  
3

FREE ELECTIVES
15
(50% of free electives must be taken at the 3000-4000 level)

TOTAL
124

*GE required course
1See prerequisites and equivalencies.
2Required of all Freshmen and
   Transfers with fewer than 10 credits.
3ENG 1030, all Major courses, and the
   Capstone require a grade of C or
   better.
4Students whose qualifying score on
   the placement test makes them eligible
   to take MATH 1054 or MATH 2415
   may take that course instead. In that
   case, MATH 1054 or MATH 2415 will
   count as the General Education
   requirement and the student may take
   another 3 or 6 credits in Free Electives
to total 124 S.H.
5Credit granted upon completion of
   elementary or intermediate foreign
   language. Three credits can be applied
to Humanities and 3 credits can be
   applied to Free Electives.

B.S. DEGREE - CHEMISTRY

OPTION: CHEMICAL
INSTRUMENTATION (ACS CERTIFIED)
For students who plan to enter professional careers in analytical
chemistry immediately after graduation
or who plan to undertake graduate study, the American Chemical Society
(ACS) requires a curriculum for professional training that includes a
series of advanced courses. The curriculum for this option is based
upon the ACS guidelines. Students completing this program are certified
by the ACS and may become members of the ACS immediately
upon graduation. Students desiring to complete the expanded option should consult the program coordinator.

GENERAL EDUCATION
REQUIREMENTS
32

FOUNDATION 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  
6
*ENG 2403 World Literature  
3
Select one course from below:
   Fine Arts or Art History  
3
Philosophy or Religion  
3
Foreign Languages  
3
(Must take I and II for credit)
   Music or Theatre  
3
Interdisciplinary  
3

SOCIAL SCIENCES  
6
*HIST 1000 History of Civil Society
   in America  
3
OR HIST 1062 Worlds of History  
3
Select one course from below:

SCIENCE & MATHEMATICS  
7
* MATH 1054 Precalculus  
3
PHYS 2095 Physics I  
4

ADDITIONAL REQUIREMENTS  
28
BIO 1300 General Biology I  
4
BIO 1400 General Biology II  
4
MATH 2415 Calculus I  
4
MATH 2416 Calculus II  
4
MATH 3415 Calculus III  
4
PHYS 2096 Physics II  
4
PHYS 2097 Physics III  
4

MAJOR AND CAPSTONE
REQUIREMENTS
60-61
CHEM 1083 Chemistry I  
4
CHEM 1084 Chemistry II  
4
CHEM 2283 Quantitative Analysis  
4
CHEM 2491 Inorganic Chemistry  
3
CHEM 2493 Descriptive Inorganic
   Chemistry Lab  
2
CHEM 2581 Organic Chemistry Lec I  
3
CHEM 2582 Organic Chemistry Lec II  
3
CHEM 2583 Organic Chemistry Lab/Rec I (WE)  
2
CHEM 2584 Organic Chemistry Lab/Rec II  
2
CHEM 3284 Instr. Methods of Analysis (WE)  
4
CHEM 3381 Physical Chemistry Lec I  
3

Economics or Geography  
3
Political Science  
3
Psychology  
3
Sociology or Anthropology  
3
Interdisciplinary  
3
CHEM 1084 Physical Chemistry Lec II 3
CHEM 3383 Physical Chemistry Lab I 2
CHEM 3384 Physical Chemistry Lab II 2
CHEM 3581 Biochemistry 3
CHEM 3583 Biochemical Techniques 3
CHEM 3902 Independent Chemistry Research (2 semesters)

OR
CHEM 4284 Exp. Analytical Problem Solving 2
CHEM 4150 Spectroscopic ID of Organic Compounds 3
CHEM 4285 Chemical Separations 3
CHEM 4481 Adv. Inorganic Chemistry 3

MAJOR/GE CAPSTONE COURSE
CHEM 4908 Seminar in Chemistry3 3

FREE ELECTIVES4 3-4
(50% of free electives must be taken at the 3000-4000 level)

TOTAL 124

1 GE required course
2 Required of all Freshmen and Transfers with fewer than 10 credits.
3 ENG 1030, all Major courses, and the Capstone require a grade of C or better.
4 Students whose qualifying score on the placement test makes them eligible to take MATH 1054 or MATH 2415 may take that course instead. In that case, MATH 1054 or MATH 2415 will count as the General Education requirement and the student may take another 3 or 6 credits in Free Electives to total 124 S.H.
5 Credit granted upon completion of elementary or intermediate foreign language. Three credits can be applied to Humanities and 3 credits can be applied to Free Electives.

CHEMISTRY MINOR
Must take each of the following:
CHEM 1083 Chemistry I
CHEM 1084 Chemistry II

Follow one of the following concentrations:

Track 1 (Analytical Chemistry Concentration) (25 Total Credits):
CHEM 2283 Quantitative Analysis
CHEM 2581 Organic Chemistry I
CHEM 2582 Organic Chemistry II
CHEM 3284 Instrumental Analysis
CHEM 4285 Chemical Separation Methods

Track 2 (Organic Chemistry Concentration) (23-24 Total Credits):
CHEM 2491 Inorganic Chemistry
OR
CHEM 2283 Quantitative Analysis
CHEM 2581 Organic Chemistry I
CHEM 2582 Organic Chemistry II
CHEM 3581 Biochemistry
CHEM 4285 Spectroscopic Identification of Organic Compounds

Track 3 (Inorganic Chemistry Concentration) (23 Total Credits):
CHEM 2491 Inorganic Chemistry
CHEM 2581 Organic Chemistry I
CHEM 2582 Organic Chemistry II
CHEM 3381 Physical Chemistry I
CHEM 4481 Advanced Inorganic Chemistry

Track 4 (Physical Chemistry Concentration) (22 Total Credits):
CHEM 2283 Quantitative Analysis
CHEM 3381 Physical Chemistry I
CHEM 3382 Physical Chemistry II
CHEM 3383 Physical Chemistry Laboratory and Rec. I
CHEM 3384 Physical Chemistry Laboratory and Rec. II

Track 5 (Biochemistry Concentration) (23-24 Total Credits):
CHEM 2491 Inorganic Chemistry
OR
CHEM 2283 Quantitative Analysis
CHEM 2581 Organic Chemistry I
CHEM 2582 Organic Chemistry II
CHEM 3581 Biochemistry
CHEM 4285 Biochemistry Techniques
CHEM 4908 may be substituted for an upper level class when appropriate and with permission from program coordinator of Chemistry Department prior to enrollment. Students can not switch between the listed tracks. Research credits may NOT be used toward the minor in Chemistry except when upper level courses have not been offered during that academic year.

CHEM 1010 Preparatory Chemistry (4)
Basic introduction to elementary chemical principles, language, calculations, and techniques. Modular approach stresses mastery of concepts. May not be used for credit toward graduation by chemistry majors (all options). (3 hr. lec./3 hr. lab.) (E)
Prerequisite: One 1000 level mathematics course. Approved General Education Distribution Course

CHEM 1030 Essentials of Chemistry (4)
Fundamental concepts in general, organic and biochemistry are covered, providing examples of chemistry in health care and real life applications. Problem solving and critical scientific thought stressed. (3 hr. lec./3 hr. lab/1 hr. recitation.) (E)
Prerequisites: One 1000 level mathematics course. Required for the Occupational Therapy Program. Approved General Education Distribution Course

CHEM 1083 Chemistry I (4)
A thorough discussion of the fundamental principles of general and inorganic chemistry such as atomic structure, ionic and covalent bonding, chemical calculations, thermodynamics and gases. Mathematical relationships and problem-solving are stressed. It is essential that the student have competence in elementary algebra. (3 hr. lec./3 hr. lab./1 hr. recitation) (E)
Corequisite: MATH 1054.
Prerequisites: High school chemistry or equivalent course and MATH 1000. Approved General Education Distribution Course

CHEM 1084 Chemistry II (4)
A continuation of Chemistry I (CHEM 1083). A thorough discussion of the basic principles of general and inorganic chemistry such as solid and liquid states, solutions, chemical kinetics and equilibrium, acid/base theories and electrochemistry. Mathematical relationships and problem-solving are stressed. (3 hr. lec./3 hr. lab./1 hr. recitation) (E)
Prerequisites: MATH 1054, CHEM 1083 or equivalent course with a grade of “C” or better. Approved General Education Distribution Course

CHEM 1200 Chemistry In Your World (3)
A modular approach to the impact of chemistry and its fundamental principles on our everyday, real world experiences. Applications, issues and concerns are explored. May not be used for credit toward graduation by chemistry majors. (3 hr. lec.) (E)
ORGANIC

CHEM 2180 Principles of Organic Chemistry
(4)
A terminal one semester course for the non-major dealing with structure and reactions of organic compounds. Industrial and medical applications are included. (3 hr. lec./3 hr. lab.) (SE) Prerequisites: CHEM 1084 or permission of the instructor.

CHEM 2581 Organic Chemistry I
(3)
This is the first half of a two-semester sequence in organic chemistry for science majors. The physical and chemical properties of organic compounds are studied using a functional group organization and a mechanistic perspective. The functional groups include alkanes, alkenes, alkyne, alkyl halides, alcohols & ethers, conjugated compounds and amines. More general topics covered include molecular orbital theory, thermodynamics & spontaneity, reaction mechanisms & kinetics, stereochemistry and spectroscopy. (3 hr. lecture) (E) Prerequisite: A grade of "C" or better in CHEM 1084.

CHEM 2582 Organic Chemistry II
(3)
The second half of a two-semester sequence in organic chemistry for science majors. The remaining organic functional groups including aldehydes & ketones, carboxylic acids, acyl halides, anhydrides, esters, amides, and amines are covered. More emphasis is placed on synthesis. The course may also include an introduction to the biochemistry of carbohydrates, lipids, proteins and nucleic acids. (3 hr. lecture). (E) Prerequisites: A grade of "C" or better in CHEM 2581.

CHEM 2583 Organic Chemistry Laboratory and Recitation I
(2)
This is the first half of a two-semester sequence in experimental organic chemistry. Examples of the major classes of organic compounds are prepared, purified and characterized using a mix of classical and state-of-the-art techniques. Practical problem solving is emphasized. (4 hour lab/1 hour rec.) (E) Corequisite: CHEM 2581 or permission of the instructor. Writing Emphasis Course

CHEM 2584 Organic Chemistry Laboratory and Recitation II
(2)
Second half of a two-semester sequence in experimental organic chemistry focusing on more advanced preparative techniques and procedures. Familiarity with standard separation and analysis methods, as well as record keeping, is expected. (4 hour lab/1 hour rec.) (E) Corequisite: CHEM 2582. Prerequisite: CHEM 2583 with a minimum grade of "C" or permission of the instructor.

CHEM 3187 Organic Chemistry Lecture III
(3)
A continuation in depth of the study of organic compounds and syntheses from a mechanistic approach. (3 hr. lec.) (E3) Prerequisite CHEM 2582.

CHEM 3189 Advanced Organic Preparations
(3)
A laboratory course designed to give the student a broader background in the synthesis of organic compounds. (1 hr. lec./6 hr. lab.) Prerequisite CHEM 2584.

CHEM 4150/5150 Spectrometric Identification of Organic Compounds
(3)
Determination of the structure of organic compounds by analysis on infrared, ultraviolet, nuclear magnetic resonance and mass spectra. Extensive use of published spectra of “unknowns.” (3 hr. lec.) Prerequisites: CHEM 2582, CHEM 3382 or permission of instructor.

CHEM 4182 Advanced Organic Preparations
(3)
A laboratory course designed to give the student a broader background in the synthesis of organic compounds. (1 hr. lec./6 hr. lab.) (E3) Prerequisite CHEM 2584.

CHEM 4183 Introduction to Physical Organic Chemistry
(3)
The application of physical chemical principles to the study of organic compounds. An introduction to conformational analysis, molecular orbital theory and resonance concepts. (3 hr. lec.) (E3) Prerequisites: CHEM 2582 and CHEM 3382.

CHEM 4184/5184 Introduction to Molecular Modeling and its Applications
(3)
Introduction to the use of computational chemistry and molecular modeling as tools for the solution of real-world research problems in chemistry and biochemistry. Students must have a fundamental understanding of the structural organic chemistry, thermodynamics, kinetics, elementary biochemistry and the general principles of quantum chemistry. (3 hr. lec.) (E3) Prerequisites: CHEM 2582, CHEM 3382 or permission of instructor.

ANALYTICAL

CHEM 2283 Quantitative Analysis
(4)
The theory, calculations, and techniques of gravimetry, titrimetry and photometric methods of analysis. Equilibria of acid/base, redox and complexation reactions are emphasized. Development of analytical laboratory skills is stressed. (3 hr. lec./6 hr. lab.) (E) Prerequisite: CHEM 1084 or equivalent with a minimum grade of C.

CHEM 3284/5284 Instrumental Methods of Analysis
(4)
General applications of modern instruments to the detection, identification and estimation of chemical elements and compounds. Laboratory exercises in the use of a variety of instruments. (3 hr. lec./3 hr. lab.) (E) Prerequisites: CHEM 2283, MATH 2415, PHYS 2057 or permission of instructor. Writing Emphasis Course

CHEM 4284 Experimental Analytical Problem Solving
(4)
A student driven laboratory course where the student is presented with an analytical problem in which identification and quantification of compounds are the primary goals. The student designs and implements a semester long research project(s) rooted in appropriate analytical chemical techniques. A written report and oral presentation of work is required. This course does not replace Independent Research. (1 hr lecture, 5 hrs Laboratory) (E3) Prerequisites: Chem 2584, Chem 3284, Chem 3383 or permission of instructor.

CHEM 4285/5285 Chemical Separation Methods
(3)
Provides background in modern chemical separation methods. Theory, instrumentation and application of distillation, selective complexation, solvent extraction and various chromatographic methods. Major emphasis will be placed on high performances - thin layer, liquid and gas chromatographic techniques. Experience with many modern and sophisticated chromatographic instruments. (3 hr. lec./ lab.) (E3) Prerequisites: CHEM 2582, 3284, 3382 or permission of instructor.

PHYSICAL

CHEM 3381 Physical Chemistry Lecture I
(5)
Detailed discussions of the theories of thermodynamics and their applications to the behavior of matter. Thermodynamic functions such as U, H, S, G and A, are defined and relationships among them are mathematically derived. The functions are applied in explaining and predicting the properties of gas, chemical equilibrium, phase change, solubility, and electrochemistry. (3 hr. lec./1 hr. rec.) (FA) Prequisites: CHEM 1084, PHYS 2096, and MATH 3415 or permission of instructor.

CHEM 3382 Physical Chemistry Lecture II (3)
Continuation of CHEM 3381 with the focus shifted to quantum chemistry, spectroscopy and chemical kinetics. The principles of quantum mechanics (including Hamiltonian, quantum numbers, wavefunctions, and orbital energy) are covered explicitly and used to formulate general molecular orbital theory. Spectroscopy is explained with similar rigor and applied in the elucidation of molecular structures. Discussions of chemical kinetics include rate law, transition state theory, thermodynamic parameters of activated complexes, and reaction mechanisms. (3 hr. lec./1 hr. rec.) (SP) Prequisite: CHEM 3381 or permission of instructor.

CHEM 3383 Physical Chemistry Laboratory and Recitation I (2)
Laboratory experience to illustrate theoretical concepts of physical chemistry with the emphasis on thermodynamics through experimental measurement. Laboratory exercises and reports will focus on obtaining the values of thermodynamic variables, such as enthalpy, entropy, and Gibbs free energy. In addition, statistical skills needed to assess data quality will be developed, and used to evaluate the need for repetition of experiments. (4 hr. lab./1 hr. rec.) (FA) Prequisite: CHEM 2283. Corequisite: CHEM 3381 or permission of instructor.

CHEM 3384 Physical Chemistry Laboratory and Recitation II (2)
A continuation of CHEM 3383 with an increased emphasis on spectroscopic and computational methods for obtaining kinetic, thermodynamic and structural information about compounds and chemical systems. Laboratory exercises and reports will focus on acquisition and interpretation of spectral data and kinetic measurements. These data will be used to elucidate the details of molecular structures, the nature of intermolecular interactions and the mechanisms of reactions. (4 hr. lab./1 hr. rec.) (SP) Prequisite: CHEM 3383. Corequisite: CHEM 3382 or permission of instructor.

CHEM 4381 Physical Chemistry III (3)
Advanced topics in physical chemistry including thermodynamics, quantum chemistry and kinetics and their relationship: thermodynamics and quantum chemistry, quantum chemistry and spectroscopy, thermodynamics of macromolecules. (3 hr. lec.) (E3) Prequisites: CHEM 3382 or permission of instructor.

INORGANIC

CHEM 2491 Inorganic Chemistry (3)
Descriptive chemistry of the Main Group elements, transition metals and rare earth metals. Emphasis on the chemical and physical properties of the elements. Discussion of periodic law, basics of nuclear chemistry and natural occurrence and industrial uses of the elements and their compounds. (3 hr. lec.) (E) Prequisites: MATH 2415; “C” or better in CHEM 1084; or permission of the instructor.

CHEM 2493 Descriptive Inorganic Chemistry Lab (2)
This course is designed to either be taken simultaneously with or after Inorganic Chemistry (CHEM 2491). The laboratory is meant to reinforce the topics covered in Inorganic Chemistry lecture and to develop skills needed for studying inorganic compounds. Labs will include qualitative analysis, synthesis of coordination complexes, and characterization techniques. (4 hrs lab) (E3) Prequisites: “C” or better in CHEM 1084; or permission of the instructor. Corequisite CHEM 2491 (the inverse does not apply)

CHEM 4481 Advanced Inorganic Chemistry (3)
Periodicity and stereochemistry of the Main Group Elements and comparative group properties. Stereochemistry and coordination chemistry of transition metals. Discussion of the theories of bonding in transition metal complexes and the Main Group elements. Nonaqueous solvents and reaction mechanisms in inorganic chemistry. (3 hr. lec.) (FA) Prequisites: CHEM 3284, CHEM 2491, CHEM 3381, CHEM 2582, or permission of instructor. Corequisite: CHEM 3382 or permission of instructor.

CHEM 4483 Inorganic Chemistry Laboratory (3)
Modern methods of synthesizing inorganic and organometallic compounds including electrolytic, high temperature and vacuum-line preparations. The study of the prepared compounds using a variety of techniques including infra-red, visible, ultraviolet spectroscopies, nuclear magnetic resonance, chromatographic, x-ray analysis and electroanalytical methods of analysis. Equilibria of acid/base, redox and complexation reactions are emphasized. Development of analytical laboratory skills is stressed. (1 hr. lec./6 hr. lab.) (SP) Prequisites: CHEM 3284, CHEM 4481.

BIOCHEMISTRY

CHEM 3581 Biochemistry (3)
This is a one-semester course designed to introduce chemistry students to the major classes of biomolecules critical for sustaining life. Molecular mechanisms of biological processes are explored with an emphasis on kinetic, thermodynamic and solution properties of biomolecules. (3 hrs. lec.) (FA) Prequisites: CHEM 2582

CHEM 3583 Biochemical Technique (3)
This course will focus on the experimental techniques to build upon the concepts acquired in Biochemistry lecture. These concepts include buffers and pH, polymerase chain reaction, enzyme purification and kinetics, amino acid pKa’s, and electrophoresis. Proper laboratory technique, use of a laboratory notebook, and the writing of laboratory reports will be stressed. (1 hr. Lec, 5 hrs Lab) (E3) Prequisites: Minimum grade of a C in CHEM 3581

SEMINARS AND INDEPENDENT STUDY

A maximum of 12 credits of chemistry research (CHEM 3801-4 and CHEM 4905-6) may be taken. Only 6 credits may be applied towards the total degree credits required for graduation.

CHEM 3500 Chemistry-Physics Cooperative Education Internship (1-3)
Selected majors in Chemistry and Chemistry-Physics test theories learned in the classroom with on-the-job experience in career related areas. Assignments and placements are arranged by the department in cooperation with the Office of Cooperative Education. Seminars, student reports and term papers required. Credits earned cannot be used to fulfill the major or cognate requirements. Application to the Coop Internship must be made during advanced registration. (E) Prequisites: CHEM 1083-4, CHEM 2283, CHEM 2581, CHEM 2583, good academic standing junior or senior status and permission of the department cooperative education committee.
For information regarding College/program mission and student learning outcomes please see http://www.kean.edu/KU/Natural-Sciences-Mission-and-SLOs

**CHEM 3901-4 Independent Chemistry**  
Research I-IV  
(1-2)  
Research problems in chemistry investigated under direction of a faculty member. Students completing two semesters of independent study under the same project director must submit a written or oral report to the departmental research committee. May be taken 4 times for credit, 1-2 credits per semester. (E)  
Prerequisites: 8 credits in chemistry plus 12 credits in 2000 level science or mathematics courses, sponsoring faculty member and approval of department chairperson.

**CHEM 4905-6 Senior Honors**  
Research I and II  
(3,3)  
Research problems in chemistry investigated under the direction of a faculty member. A progress report must be submitted to the faculty sponsor before the end of each semester. An oral report to be made before the departmental research committee at end of second semester. Seniors wishing to qualify for honors with their chemistry degree must also submit a thesis or publishable report to the departmental research committee before completing second term. (E)  
Prerequisites: CHEM 3381, 3383, a sponsoring faculty member, and approval of department chairperson. CHEM 4905 is prerequisite to 4906.

**CHEM 4908 Seminar in Chemistry**  
(3)  
After an introduction to manual and computer-assisted techniques in literature searching, the student will choose a topic. A written paper will be prepared in electronic format and an oral presentation with computer graphics made using student's skills and knowledge in Chemistry and related disciplines. Satisfies the General Education Capstone requirement for chemistry majors. (3 hrs. lec) (SP)  
Prerequisite: All GELAP requirements & permission of instructor

**CHEM 4909 Special Topics in Chemistry**  
(3)  
Study of current topics in Chemistry which are not presented in regular courses. The subject matter will vary. Topics will be announced by the department. Course may be repeated for a maximum of 6 credits. (3 hr. lec. and/or lab.) (E3)  
Prerequisite: 25 credits in Chemistry and permission of instructor.

**SONS Physics**  
Program Coordinator, Dr. Jing Gao  
B220E (908) 737-3585

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**PHYS 2095 Physics I**  
(4)  
Kinematics and dynamics of particles and extended bodies. PHYS 2095 is a calculus based introduction to the fundamentals of classical physics. Students may not receive credit for both PHYS 2095 and PHYS 2091. (3 hr. lec./3 hr. lab./1 hr. rec.) (FA)  
Prerequisite: MATH 2415.  
Corequisite: MATH 2418.  
Approved General Education Distribution Course

**PHYS 2096 Physics II**  
(4)  
Continuation of the Physics sequence. Equilibrium and elasticity, gravity, fluid mechanics, wave motion and sound, thermodynamics, and optics. PHYS 2096 is a calculus based introduction to the fundamentals of classical physics. (3 hr. lec./3 hr. lab./1 hr. rec.) (SP)  
Prerequisites: PHYS 2095, MATH 2416.  
Approved General Education Distribution Course

**PHYS 2097 Physics III**  
(4)  
PHYS 2097 is a calculus based continuation of the Physics sequence. Electricity and magnetism, Maxwell's equations, electromagnetic waves, and wave optics. Students may not receive credit for both PHYS 2097 and 2092. (3 hr. lec./3 hr. lab./1 hr. rec.) (FA)  
Prerequisites: PHYS 2096, MATH 3415.

**MODERN PHYSICS**  
**PHYS 4592 Modern Physics**  
(4)  
A rigorous survey of atomic and nuclear physics, early experimentation, incompatibility of experimental findings and classical theory, and quantum and wave mechanics approaches to understanding modern physics. (3 hr. lec./3 hr. lab.) (SE)  
Prerequisites: PHYS 2095, 2096 or permission of instructor.

**PHYS 4593 Landmark Physics of the 20th Century**  
(3)  
A rigorous survey of important theories of the twentieth century selected from Einstein's special and general theories of relativity, nuclear physics, statistical mechanics, condensed matter physics, superconductivity, superfluidity, and other topics of current interest. (3 hr. lec.) (SO)  
Prerequisites: PHYS 2095, 2096 or permission of instructor.

**INDEPENDENT STUDY**  
**PHYS 4901 Independent Physics Research**  
(1-3)  
Research problems involving current physics-related topics, either pure physics or interdisciplinary in nature, to be investigated under the guidance of a faculty director or team of co-directors.
May be repeated for credit, up to a total of six credits. Students completing two semesters of independent study under the same project director(s) must submit a formal written report. (E) Prerequisites: PHYS 2096, a sponsoring faculty member(s), and approval of the program coordinator.

Health Professions
Kean University offers an array of professional programs in nursing and health care careers. Students with an interest in any of these programs should consult the appropriate Chair or Coordinator.

PROFESSIONAL NURSING
The Baccalaureate of Science in Nursing (BSN) degree is offered to applicants who have completed lower division nursing education and hold a valid license to practice as a registered nurse (RN). The 125 credit, upper division program is accredited by the National League for Nursing Accrediting Commission (NLNAC).

POST BACCALAUREATE SCHOLL NURSE PROGRAM (NON-DEGREE)
The Post Baccalaureate School Nurse Program at Kean University is approved by the NJ State Department of Education and prepares students for certification as “School Nurse/ Instructional.”

Registered Nurses with a baccalaureate degree in any major and minimum GPA of 2.75 may apply. To apply go to www.kean.edu, please select “Apply online,” then choose the application for “Post Baccalaureate Teacher Certification.” Print a copy of the application, then carefully read and follow the directions for completion and submission.

PREPROFESSIONAL MEDICAL PROGRAMS
Premedical and Predental
Chairperson of PreMed-PreDental Committee: Dr. Matthew Mongelli C-224 (908)737-3675

Although admissions requirements are not uniform among schools of medicine and dentistry, the following two programs include the courses required for entrance by most medical and dental schools: Department of Biological Sciences - B.S. or B.A. in Biology; Department of Chemistry - B.A. in Chemistry (Preprofessional). Other major programs may be selected if electives are chosen to fulfill the requirements of the medical or dental school(s) to which the student plans to apply.

Entering or transfer students interested in medical or dental school should consult a member of the Pre-Medical Advisory Committee for advisement. Names of committee members may be secured from the department offices of either Biological Sciences or Chemistry-Physics, or by viewing the Pre-Health Professions Web Page at http://www.kean.edu/~biology/PREHEALTH.

Other Preprofessional Medical Programs
Students with an interest in veterinary medicine, optometry, pharmacy, or other preprofessional medical programs should consult a member of the Pre-Medical Advisory Committee.

MEDICAL TECHNOLOGY
Baccalaureate programs are offered in medical technology general (with options in cytotechnology and histotechnology).

This program can accommodate entering freshmen and transfer students from two or four-year institutions. The first two (preprofessional) years include general education requirements and basic courses in the sciences, mathematics and social sciences. The final two (professional) years include a sequence of courses and related clinical experiences in the professional area and advanced coursework in supporting disciplines. The curriculum has been designed to enable the graduate to meet the requirements for eligibility for national certification and is accredited by the Commission on Accreditation of Health Informatics and Information Management Education (CAHIM). Students who already have a Bachelor’s degree should contact Rutgers University (formerly UMDNJ) directly.

DUAL DEGREE PROGRAMS

OCCUPATIONAL THERAPY
The Dual Degree Program provides an opportunity to earn both an undergraduate degree in one of several majors and a Master’s degree in occupational therapy from Kean University. For more information, please refer to the Occupational Therapy section on page 204.

CLINICAL LABORATORY SCIENCE
Cytotechnologists and Medical Laboratory Scientists are clinical laboratory professionals and members of the health care team who participates in diagnosis of disease through the use of sophisticated instruments and techniques. Cytotechnologists and Medical Laboratory Scientists are needed to fill positions in hospitals, clinics and research laboratories. Qualified cytotechnologists and medical laboratory scientists play an important role in the region’s workforce. The University recognizes that duplication of certain health education programs is costly and unnecessary. Thus, a joint degree with Rutgers (formerly University of Medicine and Dentistry of New Jersey, UMDNJ), is cost effective for both universities and mutually beneficial to Kean University, its students, and Rutgers.
Health Information Management

(JOINT PROGRAM WITH RUTGERS UNIVERSITY, FORMERLY UMDNJ)

Program Liaison, Dr. Roxie James
(908) 737-3581
Program Director, Prof. Barbara Manger—Rutgers University (formerly UMDNJ)
(973) 972-4356

The Health Information Manager is a member of the health care team and is the professional responsible for management of health information systems consistent with medical, administrative, ethical and legal requirements. Health Information Management professionals are currently in high demand and this trend is expected to continue. The Bureau of Labor Statistics cites health information as one of the fastest growing occupations in the US.

The need for accurate and up-to-date health data is not confined to health care facilities. Registered Health Information Administrators (RHIA) are also being employed by Health Maintenance Organizations, insurance companies, law firms, physician offices, government agencies, consulting firms, software companies and in the pharmaceutical industry. Future health information opportunities involve planning for and implementing computerized patient record systems. As we transition to the electronic health record, professionals with technical expertise, problem solving skills, knowledge of clinical medicine and superior communication skills are needed to develop and implement new systems as well as new policies and procedures in health care documentation and to protect patient confidentiality and data security.

The Commission on Accreditation of Health Informatics and Information Management Education (CAHIIM) currently accredits the Health Information Management (HIM) Program. Upon satisfactory completion of course requirements, the graduate is eligible to apply to write the national registry examination. A passing grade on the examination establishes the graduate as a Registered Health Information Administrator (RHIA).

The HIM program is a joint program with Rutgers Newark which admits both undergraduate and second degree students. The undergraduate completes all the pre-professional coursework at Kean and two professional years at Rutgers University (formerly UMDNJ). The professional component includes didactic, laboratory and clinical experiences. Transfer students are accepted to the university as pre-professional Health Information Management majors.

For information regarding College/program mission and student learning outcomes please see http://www.kean.edu/KU/CNAHS-Mission-and-SLOs

ADMISSION REQUIREMENTS AND PROCEDURES:
In addition to the general college admission requirements, the Health Information Management program requires:
• Usually, completion of all pre-professional requirements with a "C" or above.
• Junior standing (completion of 56 semester hours) as of the Fall semester of intended enrollment at Rutgers University (formerly UMDNJ).
• An overall grade point average of 2.75 on a 4.0 scale. This requirement is subject to change. Once in the program, students must maintain an overall GPA of 2.75 in all courses and a GPA of 2.5 in HIM courses.
• Official transcripts of all previous college courses. Students who have attended a foreign college or university are required to submit an official English Translation of the academic credits.

The Health Information Management application form and official transcripts for student admission to the program must be submitted by May 1st immediately preceding the intended Fall semester enrollment.

B.S. DEGREE

GENERAL EDUCATION
32

FOUNDATIONS REQUIREMENTS
13

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

DISCIPLINARY/INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS:

Humanities
6
*ENG 2403 World Literature 3
Select one course from below
Fine Arts or Art History 3
Philosophy or Religion 3
Foreign Languages 3
Music or Theatre 3
Interdisciplinary 3

Social Sciences
6
*HIST 1000 or HIST 1062 3
Select one course below
Sociology or Anthropology 3
Political Science 3

Science & Mathematics
7
BIO 1000 Principles of Biology 4
MATH 1016 Statistics 3

ADDITIONAL REQUIRED COURSES
14-16

ID 1400 Comp. in Mod Soc & CPS 1032 Microcomp. Applic. 6
OR CPS 1231 Fundamentals of Computer Science 4
BIO 2402 Human Anatomy & Physiology 4
MGS 2030 Principles of Management 3
ACCT 2200 Principles of Accounting I 3

FREE ELECTIVES
15-17

COURSES BELOW ARE TAKEN AT RUTGERS UNIVERSITY (FORMERLY UMDNJ)

ACADEMIC MAJOR
61

FOUNDATION CORE
52

REQUIRED
Students who successfully complete this program are eligible for national certification in medical technology. The program is affiliated with the Jersey Shore University Hospital, Morristown Memorial Hospital, and The Valley Hospital. The medical technologist is a professional member of the health care team who participates in diagnosis of disease through the use of sophisticated instruments and techniques and trains other laboratory workers. Medical technologists are needed to fill positions in hospitals, clinics and research laboratories. A minimum cumulative GPA of 2.5 and a minimum GPA of 3.0 in science courses are required for application to the clinical professional phase.

**Medical Technology**

*Program Liaison, Dr. Roxie A. James*

B220C (908) 737-3581

Students who successfully complete this program are eligible for national certification in medical technology. The program is affiliated with the Jersey Shore University Hospital, Morristown Memorial Hospital, and The Valley Hospital. The medical technologist is a professional member of the health care team who participates in diagnosis of disease through the use of sophisticated instruments and techniques and trains other laboratory workers. Medical technologists are needed to fill positions in hospitals, clinics and research laboratories. A minimum cumulative GPA of 2.5 and a minimum GPA of 3.0 in science courses are required for application to the clinical professional phase.
cancer, and to report their findings to physicians. Students attend a cytotechnology educational program for clinical training. The hospital selects the students for clinical preceptorship.

**GENERAL EDUCATION**

**FOUNDATIONS REQUIREMENTS**

13 GE 1000 Transition to Kean 1
ENG 1030 College Composition 3
MATH 1016 Statistics 3
COMM 1402 Speech Communication as Critical Citizenship 3
GE 2024 Research and Technology 3

**DISCIPLINARY AND INTERDISCIPLINARY REQUIREMENTS**

19 Humanities 6
*BIO 2403 World Literature 3
Select one course from below:
Fine Arts or Art History 3
Philosophy or Religion 3
Foreign Languages 3
Music or Theatre 3
Interdisciplinary 3
Social and Behavioral Sciences 6
*HIST 1000 or HIST 1062 3
PSY 1000 General Psychology 3

*Science & Mathematics 7
*MATH 1054 Precalculus 3
CHEM 1083 Chemistry I 4

**FREE ELECTIVES** 8
(50% of electives must be taken at the 3000-4000 level.)

**TOTAL** 124

**B.S. DEGREE**

**MEDICAL TECHNOLOGY**

**OPTION: CYTOTECHNOLOGY**

The option in cytotechnology leads to both a Bachelor of Science degree and eligibility for national certification in cytotechnology. Cytotechnologists can scan slides of cells from body surfaces and body fluids to detect abnormalities; e.g.

**OPTION: HISTOTECHNOLOGY**

The option in histotechnology leads to both a Bachelor of Science degree and eligibility for national certification in histotechnology. Histotechnologists are
trained to process body tissue sections and prepare them for examination by a pathologist. Students attend a histotechnology educational program for clinical education. The hospital selects the students for clinical preceptorship.

**OPTION: GENERAL**

**GENERAL EDUCATION**
32

**FOUNDATIONS REQUIREMENTS**
13

GE 1000 Transition to Kean 1
ENG 1030 College Composition 3
MATH 1016 Statistics 3
COMM 1402 Speech Communication as Critical Citizenship 3
GE 2024 Research and Technology 3

**DISCIPLINARY AND INTERDISCIPLINARY REQUIREMENTS**
19

*Humanities* 6
  *ENG 2403 World Literature* 3
Select one course from below:
  Fine Arts or Art History 3
  Philosophy or Religion 3
  Foreign Languages 3
  Music or Theatre 3
  Interdisciplinary 3

*Social and Behavioral Sciences* 6
  *HIST 1000 or HIST 1062* 3
  PSY 1000 General Psychology 3

*Science & Mathematics* 7
  *MATH 1054 Precalculus* 3
CHEM 1083 Chemistry I 4

**ADDITIONAL REQUIRED COURSES**
21
SOC 1000 Intro to Sociology 3
CHEM 1084 Chemistry II 4

CHEM 2581 Organic Chemistry Lecture I 3
CHEM 2582 Organic Chemistry Lecture II 3
CHEM 2583 Organic Chemistry Lab I 2
CHEM 2584 Organic Chemistry Lab II 2
CHEM 2283 Quantitative Analysis 4
CAPSTONE** 0

**3 credits of ID 4881-4882 will fulfill the capstone requirement**

**Required Distribution Course**

**MAJOR REQUIREMENTS**

**MAJOR CORE REQUIREMENTS**

BIO 1300 General Biology I 4
BIO 1400 General Biology II 4
BIO 3305 Principles of Microbiology 4
BIO 3403-3404 Anatomy and Physiology I and II 8

**OR**

BIO 3433-3434 Anatomy and Physiology I and II (Honors) 3

**ADDITIONAL MAJOR REQUIREMENT**

BIO 3709 Genetics 4
BIO 4105 Essentials of Biochemistry WE 4
BIO 4315 Immunology 4

**FREE ELECTIVES**

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

TOTAL 124

**MEDICAL TECHNOLOGY CLINICAL PRECEPTORSHIPS**

ID 4877-4878 Medical Technology Clinical Preceptorship I and II (15, 15)

Course offered at an affiliated medical technology program. Clinical preceptorship in medical technology for a period of one year. Instruction and clinical practice in clinical biochemistry, medical microbiology, clinical microscopy, hematology, immunohematology, immunoserology, management, records, instrumentation, radioisotopes, ethics and others.

**Prerequisites:** Declared major in medical technology, acceptance by an affiliated MT program and consultation with the MT coordinator.

ID 4879-4880 Cytotechnology Clinical Preceptorship I and II (15, 15)

Course offered at an approved cytotechnology program. Clinical preceptorship in cytotechnology for a period of one year. Instruction and clinical practice in exfoliative cytology. Instruction and clinical practice in the microscopic study of normal and abnormal cells from body secretions and fluids, preparation and staining of cell smears, cytology of body organs, interpretation of stained cell smears for detection of malignant cells.

**Prerequisites:** Declared major in medical technology: cytotechnology option; acceptance by an approved cytotechnology program; and consultation with the MT coordinator.

ID 4881-4882 Histotechnology Clinical Preceptorship I and II (15, 15)

Course offered at an approved histotechnology program. Clinical preceptorship in histotechnology for a period of one year. Instruction and clinical practice in the processing of body tissue sections by fixation, dehydration, embedding, sectioning, mounting and staining. Other special topics studied.

**Prerequisites:** Declared major in medical technology: histotechnology option; acceptance by an approved histotechnology program; and consultation with the MT coordinator.

**Clinical Laboratory Science: Medical Laboratory Science**

Program Liaison, Dr. Roxie A. James
B220C (908)737-3581

Students who successfully complete this program are eligible for national certification in clinical laboratory science. This is a joint program with Rutgers Newark (formerly UMDNJ). The medical laboratory scientist (MLS) is a professional member of the health
care team who participates in diagnosis of disease through the use of sophisticated instruments and techniques and trains other laboratory workers. MLS are needed to fill positions in hospitals, clinics and research laboratories. A minimum cumulative GPA of 2.85 is required for application to the clinical professional phase.

For information regarding College/program mission and student learning outcomes please see http://www.kean.edu/KU/CNAHS-Mission-and-SLOs

B.S. DEGREE
CLINICAL LABORATORY SCIENCE: MEDICAL LABORATORY SCIENCE

GENERAL EDUCATION
35

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 and Technology 3

DISCIPLINARY AND INTERDISCIPLINARY REQUIREMENTS
19
Humanities 6
*ENG 2403 World Literature 3
Select one course from below:
Fine Arts or Art History 3
Philosophy or Religion 3
Foreign Languages 3
Music or Theatre 3
Interdisciplinary 3
Social and Behavioral Sciences 6
*HIST 1000 or HIST 1062 3
PSY 1000 General Psychology 3
Science & Mathematics 7

*MATH 1054 Precalculus 3
CHEM 1083 Chemistry I 4

MAJOR/GE CAPSTONE
3
BIO 4970 Seminar in Integrative Biology 3

*Required Distribution Course

MAJOR CORE REQUIREMENTS
41
BIO 1300 General Biology I 4
BIO 1400 General Biology II 4
BIO 3305 Principles of Microbiology 4
BIO 3403-3404 Anatomy and Physiology I and II 8

OR
BIO 3433-3434 Anatomy and Physiology I and II (Honors) 8
BIO 3709 Genetics 4
BIO 4105 Essentials of Biochemistry WE 4
BIO 4315 Immunology 4
BIO Major Elective @ 3000/4000 4
CHEM 2581 Organic Chemistry Lecture I 3
CHEM 2583 Organic Chemistry Lab I 2
CHEM 2584 Organic Chemistry Lab II 2

ADDITIONAL REQUIRED COURSES
15
SOC 1000 Intro to Sociology 3
CHEM 1084 Chemistry II 4
CHEM 2582 Organic Chemistry Lecture II 3
CHEM 2584 Organic Chemistry Lab II 2
MATH 1016 Statistics 3

RUTGERS MEDICAL LAB SCIENCES
45
MLSC 2119 Basic Lab Oper. 2
MLSC 2129 Hematology I 3
MLSC 2169 Body Fluids 1
MLSC 2249 Clinical Chemistry I 4
MLSC 2159 Clinical Immunology 4
MLSC 4279 Clinical Microbiology 6
MLSC 2239 Immunohematology I 3
MLSC 4349 Clinical Chemistry II 3
MLSC 4329 Hematology II 3
CLSC 4310 Lab Stat., Mgmt & Ed. 2
CLSC 4319 Introd to Mol Diagnostics 2
MLSC 4339 Immunohematology II 2
MLSC 4429 Clinical Practice Hematology & Urinalysis 2
MLSC 4449 Clinical Pract in Chem 2
MLSC 4489 Independent Study 3
MLSC 4390 Topics in MLS 1
MLSC 4439 Clinical Practice Immunohematology & Immunology 2
MLSC 4479 Clinical Practice in Microbiology 2

TOTAL
136

CLINICAL LABORATORY SCIENCE: CYTOTECHNOLOGY

Program Liaison, Dr. Roxie A. James
B220C (908)737-3581

Students who successfully complete this program are eligible for national certification in clinical laboratory science with specialization in Cytotechnology. This is a joint program with Rutgers Scotch Plains campus (formerly UMDNJ). Students receive theoretical and practical experience in all major areas of Cytotechnology, namely the female genital tract, respiratory and urinary tract, body cavity fluids, fine needle aspiration and cyto-processing of specimens. Additional experiences are provided in laboratory management, cytogenetics, independent study projects and molecular diagnostics. A minimum cumulative GPA of 2.85 is required for application to the clinical professional phase.
For information regarding College/program mission and student learning outcomes please see http://www.kean.edu/KU/CNAHS-Mission-and-SLOs

**B.S. DEGREE**

**CLINICAL LABORATORY SCIENCE: CYTOTECHNOLOGY**

**GENERAL EDUCATION**

35

**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 and Technology 3

**DISCIPLINARY AND INTERDISCIPLINARY REQUIREMENTS**

19

* **Humanities**
  - *ENG 2403 World Literature 3
  - *HIST 1000 or HIST 1062 3
  - PSY 1000 General Psychology 3
  - Science & Mathematics
    - *MATH 1054 Precalculus 3
    - CHEM 1083 Chemistry I 4

* **MAJOR/GE CAPSTONE**
  - BIO 4970 Seminar in Integrative Biology 3

*Required Distribution Course

**MAJOR CORE REQUIREMENTS**

41

- BIO 1300 General Biology I 4
- BIO 1400 General Biology II 4
- BIO 3305 Principles of Microbiology 4
- BIO 3403-3404 Anatomy and Physiology I and II 8

**OR**

- BIO 3433-3434 Anatomy and Physiology I and II (Honors) 8
- BIO 3709 Genetics 4
- BIO 4105 Essentials of Biochemistry WE 4
- BIO 4315 Immunology 4
- BIO Major Elective @ 3000/4000 4
- CHEM 2581 Organic Chemistry Lecture I 3
- CHEM 2583 Organic Chemistry Lab I 2

**ADDITIONAL REQUIRED COURSES**

19

- SOC 1000 Intro to Sociology 3
- CHEM 1084 Chemistry II 4
- CHEM 2582 Organic Chemistry Lecture II 3

**RUTGERS CYTOTECHNOLOGY**

45

- CYTO 4110 Gynecologic Cytology 4
- CYTO 4120 Gynecologic Cytology lab 4
- CYTO 4130 Fine Needle Asper. Cyto 1
- CYTO 4169 Clinical Practicum I 2
- CYTO 4289 Cytoprep Techniques I 1
- CYTO 4350 Cytogenetics 1
- CYTO 4389 Cytoprep Techniques II 2
- CYTO 4319 Intro Molecular Diagnos 2
- CYTO 4310 Lab Stat., Mgmt & Ed. 2
- CYTO 4209 Respiratory Cytology 3
- CYTO 4220 Fine Needle Asper. Cyto of the Thyroid Gland 2
- CYTO 4239 Urinary Cytology 2
- CYTO 4369 Clinical Practicum II 2
- CYTO 4370 Independent Study 2
- CYTO 4390 Gastrointestinal Cytol 2
- CYTO 4249 Body Fluids Cytology 3
- CYTO 4469 Clinical Practice III 7

**TOTAL**

138

*References – Letters of recommendation are required from two clinical sites where the field experience was obtained. In addition, one personal letter of recommendation is required.

*Other requirements – Students must submit transcripts from all colleges and universities attended and must show extracurricular or work experience that demonstrates interpersonal skills, leadership capabilities and general interest in the healthcare profession.

After application to the DPT Program, the Admissions Committee may contact applicants to schedule an interview at Rutgers University (formerly UMDNJ) in Newark.

All General Education and major requirements, as well as the following prerequisite courses:

- PSY 1000 General Psychology* 3
- CHEM 1083 Chemistry I 4
- CHEM 1084 Chemistry II 4
- BIO 3403 Anatomy and Physiology I** 4
- BIO 3404 Anatomy and Physiology II** 4
- PHYS 2091 General Physics I 4
- PHYS 2092 General Physics II 4
- MATH 2415 Calculus I 4