

# Department of Physical, Environmental, & Computer Sciences

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The Department of Physical, Environmental, & Computer Sciences (PECS) is dedicated to teaching and research in the physical sciences and technology. It offers:

1. Baccalaureate of Science Degree (BS) in Environmental Science.
2. Baccalaureate of Science Degree (BS) in Computer Science.
3. Associate of Science Degree (AS) in Computer Science.
4. Associate of Science Degree (AS) in Science (Chemistry, Physics, and Engineering concentrations)  
The AS Degree Programs are essentially transfer programs.

The **mission** of the Department is to prepare students for challenging entry level jobs in computer science, telecommunications, applied sciences and environmental/health fields, as well as for graduate programs in environmental science, chemistry, atmospheric sciences, education and computer science. Accordingly, the Department focuses on the following goals:

1. to develop in our students high-level skills, such as problem solving, reasoning, and research capabilities;
2. to prepare students for graduate study in the Environmental and Computer Sciences, and BS Programs in Chemistry, Physics and Engineering;
3. to prepare students to compete for well-paying positions in the applied and environmental sciences;

4. to prepare students to create their own position in society (e.g. consulting, entrepreneurship) regardless of the economic climate.

## Academic Standards

Students in the Department must pass all departmental required courses with a grade of "C" or better.

## NASA and NSF Programs

NSF New York City Louis Stokes Alliance for Minority Participation (NYC-LSAMP) Program is a consortium of sixteen baccalaureate and Associate degree granting CUNY campuses and the Graduate School and University Center. It funds activities such as:

1. Smaller Science and Mathematics Classes
2. Curriculum Development
3. Student Support through Learning Centers
4. Students' Stipends for Tutoring
5. Undergraduate Research
6. Student Research Stipends

NASA Goddard Institute for Space Studies (GISS) Institute on Climate and Planets (ICP) is a collaboration between the Goddard Institute for Space Studies, the NYC-AMP project at CUNY, and the New York Public Schools. It involves college and high school students, their faculty, and GISS scientists in a team approach to carry out research projects in climate and planetary research. A summer institute provides an intensive academic and research experience with scientific collaboration continuing during the academic year both at GISS and on campus.

NASA Atmospheric/Ocean and Environmental Science Research Program is a collaboration between PECS and GISS. This campus based research program provides undergraduate and high school students the opportunity to be part of the NASA Earth Science Enterprise.

NASA Science and Technology Teachers for the Next Millennium Program is a collaborative effort between Medgar Evers College (CUNY) and the City College of New York (CUNY), which provides science and technology majors with the opportunity, knowledge, and skills to become teachers of secondary school science and technology in an urban, multicultural environment.

NASA Minority University Information (MU-SPIN) CUNY Network Resources and Training Site (NRTS) Network is a collaboration involving City College, Medgar Evers College, LaGuardia Community College, York College,

and Queensborough Community College in order to develop an information infrastructure on each campus that may be applied to research and education activities.

New York State Department of Education Graduate Research Technology Initiative assisted in providing a dedicated network for faculty and student research, instructional use, and research related activities for students in the introductory chemistry and physics courses.

The New York City Space Science Research Alliance (NYC-SSRA), funded by the NASA Office of Space Science, is initiating and enhancing multiple collaborations in Space Science research and has developed a BS Degree in Space Science in the City University of New York City University of New York Baccalaureate Degree Program. The Alliance is a coalition of CUNY Colleges, Hayden Planetarium of the American Museum of Natural History, NASA Goddard Space Flight Center, and NASA Goddard Institute for Space Studies.

Undergraduate research includes:

1. Planetary Science
2. Earth-Sun Connection
3. Astrophysics

**Bachelor of Science in Environmental Science**

This Baccalaureate Degree Program in Environmental Science stresses that environmental science is about much more than science. It is also about ethics, responsibility, and values, as well as sociology, politics, law, and business. For graduates to be effective in the work place, this interdisciplinary perspective must always be in focus.

**Numerous job opportunities are available for Environmental Science graduates in industry and at various levels in local, state, regional and federal governments.** Environmental Science graduates may find immediate employment in areas indicated below, as businesses both large and small continue to comply with regulations.

1. Industrial Hygienist
2. Chemical Hygiene Officer
3. OSHA Officer
4. Waste Management Consultant
5. Training Consultant

**On account of new laws and regulations, most of which emanate from federal agencies such as the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA), businesses are now preoccupied with compliance.**

This program also emphasizes environmental law which is the forerunner for environmental management and environmental policy. The program also addresses con-

servation through courses in Natural Resource Conservation and Management and Ground Water. The relationship with The Museum of Natural History and the Prospect Park Alliance will afford additional depth on the issue of conservation. This program facilitates a smooth transition to graduate programs in science and engineering.

The BS in Environmental Science Program requires 120 credits consisting of the following category of courses and credits:

<b>Courses</b>	<b>Credits</b>
College-wide core	28
Departmental	86
Electives	6

This program of study includes the required College-wide Curriculum.

**Recommended Sequence for the Bachelor of Science in Environmental Science**

<b>Semester 1</b>		<b>Credits</b>
<b>Courses</b>		
ENGL 112	College Composition I	3
FS 101	Freshman Seminar I	1
MTH 202	Calculus I	4
CHM 201	General Chemistry I	4
SPCH 102	Fundamentals of Speech	3
	<b>Total</b>	<b>15</b>

<b>Semester 2</b>		<b>Credits</b>
<b>Courses</b>		
ENGL 150	College Composition II	3
FS 102	Freshman Seminar II	1
MTH 202	Calculus II	4
CHM 202	General Chemistry II	4
ENVS 200	Environmental and Health Issues	3
	<b>Total</b>	<b>15</b>

<b>Semester 3</b>		<b>Credits</b>
<b>Courses</b>		
ENGL 211	Intro to Literature	3
ENVS 203	Environmental and Occupational Laws	3
MTH 203	Calculus III	4
CHM 303	Organic Chemistry I	4
	<b>Total</b>	<b>14</b>

<b>Semester 4</b>		<b>Credits</b>
<b>Courses</b>		
	<b>Science Elective</b>	<b>3</b>
CS 151	Introduction to Computing	3
PHY 211	University Physics I	4
ENVS 301	Air and Water Pollution	3
ENGL 212	Masterpieces of World Literature	3
	<b>Total</b>	<b>16</b>

<b>Semester 5</b>		<b>Credits</b>
<b>Courses</b>		
ENVS 302	Measurement and Instrumentation	4

CHM 311	Quantitative Analysis	4
PHY 212	University Physics II	4
PHIL 101	Intro to Logic	3
	Total	15
<b>Semester 6</b>		
<b>Courses</b>		<b>Credits</b>
ENVS 313	Waste Management	3
ENVS 400	Natural Resource Conservation and Management	3
PHY 213	University Physics III	4
BIO 201	General Biology I	4
	<b>International Core Option</b>	3
	Total	17
<b>Semester 7</b>		
<b>Courses</b>		<b>Credits</b>
ENVS 401	Ground Water	3
ENVS 413	Field Study	3
BIO 370	Ecology	3
HIST 101	World Civilization	3
	Elective	3
	Total	15
<b>Semester 8</b>		
<b>Courses</b>		<b>Credits</b>
ENVS 404	Internship	3
ENVS 405	Pollution Control and Prevention	3
SSC 101	Culture, Society, and Social Change or	
SSC 305	Critical Issues in Society or	
PSYC 101	Intro to Psychology	3
	<b>History Core Course</b>	3
	<b>Elective</b>	3
	Total	15
<b>Total Credits Required for the BS in Environmental Science</b>		<b>120</b>

## THE COMPUTER SCIENCE PROGRAM

### "Time, Effort, Integrity"

The discipline of Computer Science requires a great deal of time and an honest effort on the part of those who study it! Our motto is: "Time, Effort, Integrity."

Computer Science is concerned with computers, their organization, the theory which underlies their existence, and their application. The Computer Science Program at Medgar Evers College prepares students with the core theoretical and applied knowledge, incorporating national computer science curriculum standards required for a professional or research career in a dynamic and evolving discipline. The program follows the guidelines of the Association for Computing Machinery (ACM) and the Computer Society of The Institute of Electrical and Electronics Engineers (IEEE-CS) Joint Curriculum Task Force,

and combines rigorous academic study with the opportunity for a "hands-on/minds-on" experience.

Students enrolled in the Computer Science Program are provided with a strong mathematics, science, and core computer science background. The BS Degree Program in Computer Science offers concentrations in the areas of Software, Telecommunications, and Computational Science. An important component of the Computer Science Program is the requirement for student internships and/or undergraduate research to develop the skills and expertise needed for success in industry and graduate school. The Computer Science Program also provides students with the opportunity to take examinations for technical certification, and offers workshops to support those efforts. The AS Degree in Computer Science is awarded to students who successfully complete the first two years of the BS Degree requirements in Computer Science.

### Computing Facilities

The Medgar Evers College Research and Computing Facility, used by students and faculty, consists of several advanced microcomputer labs utilizing Microsoft Windows 2000 Server, Windows XP, Linux, Macintosh based machines, and the campus Local Area Network. The LAN provides campus computers with high-speed communications and a gateway to other CUNY computer resources and the Internet. There are twenty-one (21) computer labs supporting over 400 machines with support for various academic applications. Selected labs contain computerized projection-based systems for instructor-led courses.

The advanced computing lab, in the Department of Physical, Environmental and Computer Sciences, serves as an instruction and problem-solving lab for Linux systems research, education and practice. The graphics workstations in this lab enable faculty and students to use advanced data visualization techniques, including Computer-Aided Design (CAD) software, Image Definition Language (IDL), Advanced Visualization System (AVS), and MATLAB. Additionally, the Medgar Evers College Computing Center interfaces with the City University Computing Center, one of the nation's most powerful university computer installations.

### The Computer Science Minor

Students from other disciplines may minor in computer science. A minor in computer science consists of twelve (12) credits including CS 151, CS 244, CS 246 and a three (3) credit computer science elective, which must be at the 300 level, or selected from a course requiring data structures as its prerequisite. All 12 credits must have a grade of 'C' or better. Courses that substantially duplicate material covered in other courses for which credit has been granted are not acceptable.

**Note:** CS 100 may not be applied toward the BS or AS Computer Science degrees, or the CS minor.

**All 16 credits must have a grade of "C" or better.**

**Bachelor of Science in Computer Science**

The satisfactory completion of one hundred twenty (120) credits of prescribed courses is required for the BS Degree in Computer Science. The work comprises thirty-four (34) credits of College Core requirements, seventy (70) credits of Departmental requirements:

1. Forty-three (43) credits of Computer Science
2. Twenty-three (23) credits of Mathematics (Calculus) and Science
3. Twelve (12) credit Computer Science concentration in:
  - a. Software
  - b. Telecommunications, or
  - c. Computational Science
4. Eight (8) credits of Open Electives

**BACHELOR OF SCIENCE IN COMPUTER SCIENCE**

**College Core Requirements**

<b>Courses</b>	<b>Credits</b>
ART 100 Intro to World Art or	
MUS 100 Intro to World Music	2
BIO 101 Intro to the Science of Biology	3
ENGL 112 College Composition I	3
ENGL 150 College Composition II	3
ENGL 211 Intro to Literature	3
ENGL 212 World Literature: The Evolving Canon	3
FS 101 Freshman Seminar I	1
FS 102 Freshman Seminar II	1
HIST 101 World Civilization I or	
HIST 102 World Civilization II	3
HIST History Elective	3
<b>Select One:</b>	
HIST: 200, 201, 230, 231, 242 Social Science / Philosophy CORE Course	3
<b>Select One:</b>	
PHIL 101, PSYC 101SSC 101, SSC 305	3
SPCH 102 Fundamentals of Speech	3
Total	34
INTERNATIONAL OPTION	3

**Computer Science Requirements**

<b>Courses</b>	<b>Credits</b>
CS 151 Intro to Computing	3
CS 241 Discrete Structures	3
CS 244 Object-Oriented Programming and Design	3
CS 246 Data Structures	3
CS 252 Assembly Language and Architecture	3

CS 260	Digital Systems	4
CS 280	Artificial Intelligence	3
CS 300	Theoretical Computer Science	3
CS 325	Computer Architecture	3
CS 345	Scientific Programming I-Data Analysis	3
CS 315	Operating Systems	3
CS 401	Computer Science Internship/ Research I	3
CS 381	Database Systems	3
CS 402	Computer Science Internship/ Research II	3
Total		43

**Mathematics and Science Requirements**

<b>Courses</b>	<b>Credits</b>
MTH 202 Calculus I	4
MTH 203 Calculus II	4
MTH 237 Probability and Statistics	3
PHY 211 University Physics I	4
PHY 213 University Physics III	4
PHY 309 Electronics or	
PHY 212 University Physics II	4
Total	23

**Software Concentration/Electives  
(Select One Area)**

Software, Telecommunications, or Computational Science	12
Open Electives	8

**Computer Science Areas of Concentration  
and Electives**

<b>Courses</b>	<b>Credits</b>
CS 265 UNIX Systems Programming	3
CS 278 Robot Programming	3
CS 301 Software Development (Java Implementation)	3
CS/TLC305 Data Communications and Web Technologies	3
CS/TLC307 Local and Wide Area Networks	3
CS/TLC309 Network Programming	3
CS 310 Special Topics in Computer Science	3
CS 312 Analysis of Algorithms	3
CS 319 Geographical Information Systems	3
CS 321 Remote Sensing	3
CS 350 Programming Language Paradigms	3
CS 360 Software Engineering	3
CS 392 Advanced Topics in Computer Science	3

**Telecommunications Concentration  
and Electives**

<b>Courses</b>	<b>Credits</b>
TLC/PHS221 Telecommunications Systems	3
CS 301 Software Development (Java)	

	Implementation)	3	FS	101	Freshman Seminar I	1
CS/TLC305	Data Communications and Web Technologies	3			Total	16
CS/TLC307	Local and Wide Area Networks	3				
CS/TLC309	Network Programming	3				
PHY 351	Intermediate Electromagnetic Theory	3				
TLC 311	Signaling and Transmission Theory	3				
TLC 317	Digital Communications Systems	3				
TLC 340	Network and Systems Evaluation	3				
TLC 371	Network Design	3				
TLC 421	Special Topics in Telecommunications	3				

\*\* Computational Science, Concentration, and Electives

Courses		Credits
CS 319	Geographical Information Systems	3
CS 321	Remote Sensing	3
CS 390	Scientific Programming II - Models and Simulations	3

Additional Computational Science elective courses must be chosen from advanced courses in the following areas:

1. Biology
2. Chemistry
3. Earth Systems
4. Environmental Science
5. Mathematics
5. Physics

Within these fields, the following courses are not acceptable:

1. Courses at the 100 Level.
2. Courses that have no pre-requisites.
3. Courses that substantially duplicate material covered in other courses for which credit has been granted.

\*\* Students who choose the Computational Science Concentration are required to consult with a Computer Science Program Advisor when designing their concentration, and choosing computational science electives.

### Recommended Sequence for the BS degree in Computer Science

#### FIRST YEAR

##### First Semester

Courses		Credits
CS 151	Intro to Computing	3
MTH 202	Calculus I	4
ENGL 101	Freshman English or	
ENGL 112	College Composition I	3
SPCH 102	Fundamentals of Speech	3
ART 100	Intro to World Art or	
MUS 100	Intro to World Music	2

#### Second Semester

Courses		Credits
CS 241	Discrete Structures	3
CS 244	Object-Oriented Programming and Design	3
MTH 203	Calculus II	4
ENGL 150	College Composition II	3
	Social Science/Philosophy CORE Course	3

#### Select One:

PHIL 101, PSYC 101, SSC 101, SSC 305

FS	102	Freshman Seminar II	1
		Total	17

#### SECOND YEAR

##### Third Semester

Courses		Credits
CS 246	Data Structures	3
CS 252	Assembly Language and Architecture	3
*MTH 237	Probability and Statistics	3
ENGL 211	Intro to Literature	3
HIST 101	World Civilization I or	3
HIST 102	World Civilization II	3
	Total	15

##### Fourth Semester

Courses		Credits
CS 260	Digital Systems	4
CS 280	Artificial Intelligence	3
CS CS	Concentration/Elective	3
PHY 211	University Physics I	4
HIST	History Elective	3
	<b>Select One:</b> HIST: 200, 201, 230, 231, 242	
	Total	17

\* **Note:** The AS Degree in Computer Science is awarded to students who complete the first two years of the BS degree requirements outlined above.

**MTH 237 is not a requirement for this AS Degree.**

#### THIRD YEAR

##### Fifth Semester

Courses		Credits
CS 300	Theoretical Computer Science	3
CS 325	Computer Architecture	3
CS 345	Scientific Programming I-Data Analysis	3
PHY 213	University Physics III	4
ENGL 212	World Literature: The Evolving Canon	3
	Total	16

**Sixth Semester**

Courses	Credits
CS 315 Operating Systems	3
CS Concentration/Elective	3
BIO 101 Intro to the Science of Biology	3
PHY 309 Electronics	
or	
PHY 212 University Physics II	4
<b>Total</b>	<b>13</b>

**FOURTH YEAR**
**Seventh Semester**

Courses	Credits
CS 401 Computer Science Internship/ Research I	3
CS 381 Database Systems	3
CS Concentration/Elective	3
Open Elective	4
<b>Total</b>	<b>13</b>

**Eighth Semester**

Courses	Credits
CS 402 Computer Science Internship/ Research II	3
CS Concentration/Elective	3
Open Elective	4
International Option	3
<b>Total</b>	<b>13</b>

**Total Credits Required for the BS Degree in Computer Science 120**

**Associate of Science in Computer Science**

This Associate Degree Program is designed to encourage AS Degree graduates to enter into our BS Degree Program in Computer Science, and related programs in Computer Engineering, Telecommunications, or Applied Sciences. The program integrates seamlessly with our BS Degree Program in Computer Science and serves as its foundation. The AS Degree in Computer Science is awarded to students who successfully complete the first two years sixty (60) credits of the BS Degree requirements in Computer Science. These requirements include:

Courses	Credits
College Core	25
Computer Science	22
Mathematics	8
Science	4
Computer Science Concentration/Elective	1
<b>Total</b>	<b>60</b>

**ASSOCIATE OF SCIENCE IN COMPUTER SCIENCE**

College Core Requirements Courses	Credits
ART 100 Intro to World Art	
or	
MUS 100 Intro to World Music	2
ENGL 112 College Composition I	3
ENGL 150 College Composition II	3
ENGL 211 Intro to Literature	3
FS 101 Freshman Seminar I	1
FS 102 Freshman Seminar II	1
HIST 101 World Civilization I	
or	
HIST 102 World Civilization II	3
HIST History Elective	3
<b>Select One:</b>	
HIST: 200, 201, 230, 231, 242	
Social Science/Philosophy	
CORE Course	3
<b>Select One:</b>	
PHIL 101, PSYC 101, SSC 101, SSC 305	
SPCH 102 Fundamentals of Speech	3
<b>Total</b>	<b>25</b>

**Computer Science Requirements**

Courses	Credits
CS 151 Intro to Computing	3
CS 241 Discrete Structures	3
CS 244 Object-Oriented Programming and Design	3
CS 246 Data Structures	3
CS 252 Assembly Language and Architecture	3
CS 260 Digital Systems	4
CS 280 Artificial Intelligence	3
<b>Total</b>	<b>22</b>

**Mathematics and Science Requirements**

Courses	Credits
MTH 202 Calculus I	4
MTH 203 Calculus II	4
PHY 211 University Physics I	4
<b>Total</b>	<b>12</b>

**Computer Science Concentration/Elective 1**  
The (one) 1-credit computer science elective may be satisfied by completing either: a 300-level computer science course, a course requiring data structures as its prerequisite, or by completing a course chosen from one the following areas:

1. Biology
2. Chemistry
3. Earth Systems
4. Environmental Science
5. Mathematics
5. Physics

Within these fields, the following courses are not acceptable:

1. Courses at the 100 Level.
2. Courses that have no pre-requisites.
3. Courses that substantially duplicate material covered in other courses for which credit has been granted.

**Recommended Sequence for the ASSOCIATES OF SCIENCE degree in Computer Science**

**FIRST YEAR**

**First Semester**

<b>Courses</b>		<b>Credits</b>
CS 151	Intro to Computing	3
MTH 202	Calculus I	4
ENGL 101	Freshman English	
	or	
ENGL 112	College Composition I	3
SPCH 102	Fundamentals of Speech	3
ART 100	Intro to World Art	
	or	
MUS 100	Intro to World Music	2
FS 101	Freshman Seminar I	1
	<b>Total</b>	<b>16</b>

**Second Semester**

<b>Courses</b>		<b>Credits</b>
CS 241	Discrete Structures	3
CS 244	Object-Oriented Programming and Design	3
MTH 203	Calculus II	4
ENGL 150	College Composition II	3
	Social Science/Philosophy CORE Course	3
	<b>Select One:</b>	
	PHIL 101, PSYC 101, SSC 101, SSC 305	
FS 102	Freshman Seminar II	1
	<b>Total</b>	<b>17</b>

**SECOND YEAR**

**Third Semester**

<b>Courses</b>		<b>Credits</b>
CS 246	Data Structures	3
CS 252	Assembly Language and Architecture	3
ENGL 211	Intro to Literature	3
HIST 101	World Civilization I	
	or	
HIST 102	World Civilization II	3
	<b>Total</b>	<b>12</b>

**Fourth Semester**

<b>Courses</b>		<b>Credits</b>
CS 260	Digital Systems	4
CS 280	Artificial Intelligence	3
CS	Concentration/Elective	1
PHY 211	University Physics	4
HIST	History Elective	3

**Select One:**

HIST: 200, 201, 230, 231, 242

Total 15

**Total Credits Required for the AS Degree in Computer Science**

**60**

**Computer Science Areas of Concentration**

1. Software
2. Telecommunications
3. Computational Science

**COURSE DESCRIPTIONS**

**ASTRONOMY**

**AST 103 Astronomy**

3 credits; 3 class hours; 1 lab hour

This course is an introductory study of the structure of the universe from the Earth to the limit of the observable universe. Topics include stellar structure and evolution, the solar system, the Milky Way, galactic structure, and theories of the universe. Recent topics such as extraterrestrial life, neutron stars and pulsars, black holes, quasars, and background radiation are also discussed. *Pre-requisites: Math and Language Basic Skills*

**AST 215 Space Science I**

4 credits; 3 class hours; 3 lab hours

This course covers the fundamental concepts in Space Science. Topics include: Newton's laws of motion and universal law of gravity, vector algebra; the solar system, celestial mechanics, comparative planetology: Earth-moon system, Terrestrial planets, Jovian planets, atmospheres and geology, small bodies, exploration and water-life,



electromagnetic radiation and atomic structure, telescopes and detectors; the Sun: structure, solar magnetism and energy transformations; Earth-Sun connection and geospace. Part of course may be held at the Hayden Planetarium of the American Museum of Natural History or the NASA Goddard Institute for Space Science.

*Co-requisite: MTH 202 Calculus*

### **AST 216 Space Science II**

3 credits; 3 class hours; 3 lab hours

This course covers the fundamental concepts in Space Science. Topics include: Multiple wavelength astronomy: radio, infrared, optical, UV, x-ray and gamma ray; stars: energy transport, magnitude and distance modulus; variable and binary stars, Hertzsprung-Russell diagram; interstellar medium, stellar structure and evolution; Milky Way galaxy: stellar distribution and population; galactic structure and evolution: active galaxies and quasars; Hubble's law; large scale structure of the universe: galaxy clusters and cosmology. Part of the course may be held at the Hayden Planetarium of the American Museum of Natural History or the NASA Goddard Institute for Space Science.

*Pre-requisite: AST 215 Space Science I or MTH 202 Calculus I.*

## **CHEMISTRY**

### **CHM 104 Chemistry and Our World**

4 credits; 3 class hours; 1 lab hours

This is an introductory chemistry course intended for non-science majors. It will introduce students to the basic concepts of chemistry with an emphasis on the role the subject plays in the world around us and in the service of man.

*Pre-requisite: Completion of all remedial math courses*

### **CHM 105 Chemistry for Health Professionals I**

4 credits; 3 class hours; 3 lab hours

An introductory course for the health professional student covering the fundamentals of general and organic chemistry with applications in biological sciences. Topics include the structure, properties, and states of matter, chemistry bonding and reactions, chemistry of solutions, and the chemistry of major groups of organic compounds. This is not the pre-requisite (s) for organic chemistry.

*Pre-requisites: Pass all Basic Skills*

### **CHM 106 Chemistry for Health Professionals II**

4 credits; 3 class hours; 3 lab hours

An introductory course designed to develop fundamentals of biochemistry with application in the life sciences. Topics include the biochemistry of the cell, chemistry of carbohydrates, proteins, lipids, and nucleic acids, principles of metabolism, regulation and control, genetics, and biochemistry of drugs.

*Pre-requisite: CHM 105*

### **CHM 112 Basic Chemistry**

3 credits; 4 class hours

An introductory course designed for students who plan further study in chemistry. The course presents those areas of chemistry which are essential and which students find most difficult in general college chemistry. These include the mole concept, nomenclature, stoichiometric calculations, gas laws, and solution concentration calculations.

*Co-requisite: MTH 130*

### **CHM 201 General Chemistry I**

4 credits; 3 class hours; 3 lab hours; 1.5 workshop hours

An introduction to the basic principles and theories of chemistry including atomic theory, laws of chemical combination, periodic classification of the elements, states of matter, and kinetic molecular theory. The aim of classroom and laboratory work is to prepare the student for advanced study in chemistry.

*Pre-requisite: CHM 112 or permission of chairperson*

*Co-requisite: MTH 151*

### **CHM 202 General Chemistry II**

4 credits; 3 class hours; 3 lab hours; 1.5 workshop hours

A continuation of CHEM 201. Topics include the study of liquids, solids and solutions, chemical kinetics, equilibrium, acids and bases, thermodynamics and electrochemistry.

*Pre-requisite: CHM 201*

### **CHM 303 Organic Chemistry I**

4 credits; 3 class hours; 3 lab hours; 1.5 workshop hours

The structure, preparation and properties of organic compounds with emphasis on reactivity, reaction mechanisms, stereochemistry and synthesis. Laboratory studies include modern experimental and research techniques for preparing, purifying and identifying organic compounds, and the use of polarimeter, infra-red and ultraviolet spectrometers, NMR, and chromatography.

*Pre-requisite: CHM 202*

*Co-requisite: MTH 203*

### **CHM 304 Organic Chemistry II**

4 credits; 3 class hours; 3 lab hours; 1.5 workshop hours

The structure, preparation and properties of organic compounds with emphasis on reactivity, reaction mechanisms, stereochemistry and synthesis. Laboratory studies include modern experimental and research techniques for preparing, purifying and identifying organic compounds, and the use of polarimeter, infra-red and ultraviolet spectrometers, NMR, and chromatography.

*Pre-requisite: CHM 303*

*Co-requisite: CHMW 304*

### **CHM 311 Quantitative Analysis**

4 credits; 2 class hours; 6 lab hours

Basic methods in quantitative analysis; theory and techniques of calorimetric, volumetric, and gravimetric determinations. Instrumental analysis using spectrophotometers,

gas chromatograph, and NMR.

*Pre-requisite: CHM 202*

### **CHM 321 Physical Chemistry I**

3 credits; 3 class hours; 1 recitation hour

This course in physical chemistry provides a theoretical understanding of chemical phenomena. Topics include the laws of thermodynamics, the kinetic theory of gases, statistical mechanics, chemical equilibrium, phase equilibrium, electrochemistry, and quantum mechanics.

*Pre-requisites: CHM 202, PHY 212 and PHY 213*

*Co-requisite: MTH 204*

### **CHM 322 Physical Chemistry II**

3 credits; 3 class hours; 1 recitation hour

This course is a continuation of Physical Chemistry I. Topics include reaction kinetics, photochemistry, macromolecules, molecular electronic structure, symmetry, spectroscopy, solid state chemistry and surface dynamics.

*Pre-requisite: CHM 321*

### **CHM 341 Biochemistry**

4 credits; 3 class hours; 3 lab hours

This course concerning the chemical characteristics of living matter. Topics include general concepts of the cell, biomolecules, carbohydrates, amino acids, peptides, protein structure and function, lipids, enzymes, citric acid cycle and nucleic acids. Laboratory studies include modern experimental and research techniques in Biochemistry.

*Pre-requisite: CHM 304*

### **CHM 351 Environmental Organic Chemistry**

4 credits; 6 class hours

This course is designed to provide some understanding of how molecular interactions and macroscopic transport phenomena determine the distribution in space and time of organic compounds released into the natural environment. Students will be trained on the technique of using chemical structure to deduce physical properties and reactivities. Students will eventually be able to construct mathematical models to evaluate the fates of organic compounds in the environment.

*Pre-requisite: Organic Chemistry I (CHM 303)*

### **CHM 405 Advanced Organic Chemistry**

4 credits; 6 class hours

The well-motivated organic chemistry student is in desperate need of a course that may serve as a transition between undergraduate and graduate organic chemistry. Such a course must be designed to take full advantage of the spirit, energy and enthusiasm that descends upon these students as they near completion of the second half of their undergraduate organic chemistry. This course has a research component.

*Pre-requisite: Organic Chemistry II (CHM 304)*

### **CHM 421 Inorganic Chemistry**

5 credits; 3 class hours; 6 lab hours

This is the first of three courses in modern inorganic chemistry. It serves to introduce the challenged student to an ever expanding and important field of chemistry. This new course will involve a detailed discussion of the chemistry of selected 'Main Group' elements, covering the reactions of the elements and their compounds, as well as structure and bonding. Students who register for the course must also register for the laboratory part of the course.

*Pre-requisite: CHM 303 Organic Chemistry I*

### **CHM 422 Inorganic Chemistry II**

5 credits; 3 class hours; 6 lab hours

This is the second of three courses in modern inorganic chemistry. It serves to expose the students to one of the most exciting fields of chemistry. This new course will entail a study of the systematic chemistry of the first transition series (3d) elements, covering the reactions of the elements and their compounds, as well as structure and bonding, electronic spectra, and magnetic properties. Students who register for the course must also register for the laboratory part of the course.

*Pre-requisite: Inorganic Chemistry*

### **CHM 523 Inorganic Chemistry III (Organometallic Chemistry)**

4 credits; 3 class hours; 3 lab hours

This is the third and last of three courses in modern inorganic chemistry. It serves to expose the students to a branch of chemistry which bridges the traditional fields of organic and inorganic chemistry. This new course will entail a study of the organometallic chemistry of the first transition series (3d) elements, covering the synthesis, reactions and bonding of selected compounds. Industrially important reactions involving organometallic compounds will be dealt with in detail.

*Pre-requisite: Inorganic Chemistry II*

### **CHM 561 Spectrometric Identification of Organic Compounds**

4 credits; 4 class hours; 3 lab hours

This course is designed to teach the Organic Chemistry student how to identify organic compounds from the complementary information afforded by mass spectra, infrared spectra (I.R.), nuclear magnetic resonance (nmr) spectra and ultraviolet (U.V.) spectra. The modern undergraduate chemistry student requires a somewhat modest level of expertise and sophistication in each of these four levels of spectrometry. This course would further prepare students for the techniques and methodologies they would encounter in graduate programs.

*Pre-requisite: CHM 304 Organic Chemistry II*

**COMPUTER SCIENCE****CS 100 Internet and Web Technologies**

3 credits; 3 class hours

This course provides students with practical knowledge about computer hardware and software, and a basic understanding of the underlying telecommunications technology of the Internet. Students learn to navigate and search the Internet, while exploring numerous research-related web sites using E-mail, FTP, WAIS and Telnet services. After exploring and using HTML to create Web pages, JavaScript is introduced and used for developing client-side applications for Web browsers. These markup and script languages are used to introduce computer programming fundamentals. Students produce a publishable home page or other Web document as their final course project.

*Co-requisite: MTH 138 or Higher*

**CS 151 Introduction to Computing**

3 credits; 3 class hours; 1 lab hour

This course introduces the fundamental concepts of the discipline of computing, emphasizing elementary facts concerning computer architecture, programming languages, software methodology, and algorithms. Students learn how to solve problems using an appropriate block-structure high-level programming language. Programming topics include: basic data structures, control structures, data and procedure abstractions, functions and function parameters, recursion, pointers, classes and file processing.

*Co-requisite: MTH 151 Pre-Calculus*

**CS 241 Discrete Structures**

3 credits; 3 class hours; 1 lab hour

The objective of this course is to introduce the elements of discrete mathematics systems pertinent to the field of computer science. Through computer programming examples, exercises and case studies, students are taught the following mathematical concepts: sets and binary relations, functions, first-order logic, proof techniques, algebraic systems, graph theory, vectors and matrices, elementary probability theory, combinatorial computing and counting arguments. Definitions and analysis of algorithms are also introduced.

*Pre-requisite: CS 151*

**CS 244 Object Oriented Programming and Design**

3 credits; 3 class hours; 1 lab hour

This course presents an object-oriented approach to software development used in large-scale programming projects. A software engineering methodology, such as the Unified Modeling Language (UML), will be used for object, dynamic, and functional modeling. Students learn how to implement a system using an appropriate object-oriented programming language. Programming topics include: Classes and data abstraction, operator overload-

ing, inheritance, virtual functions and polymorphisms, templates, exception handling, and class libraries including GUI applications.

*Pre-requisite: CS 151*

**CS 246 Data Structures and Algorithms**

3 credits; 3 class hours; 1 lab hour

This course introduces the different ways that data is organized and stored in computer memory and the relevant procedures used in the manipulation of that data. The idea of abstract data types (ADTs) is first introduced, and then reinforced through the characterization of fundamental data structures in the discipline - stacks, queues, and trees. Other topics are recursive algorithms, dynamic storage, and complexity. Algorithms for searching and sorting are also implemented.

*Pre-requisite: CS 241 and CS 244*

**CS 252 Assembly Language and Architecture**

3 credits; 3 class hours; 1 lab hour

In assembly language and architecture, students are exposed to the register level architecture of a modern processor and gain experience programming in the assembly language for that processor. ALU, memories, and interfaces are covered. Emphasis is placed on machine language, instruction formats and executions, addressing and indexing, computation and control instructions, and digital representation of data. Program segmentation, linkage, subroutine calling conventions, and floating-point operations are also discussed.

*Pre-requisites: CS 244 Object Oriented Programming and Design*

**CS 260 Digital Systems**

4 credits; 3 class hours; 3 lab hours

This course presents the theoretical principles and mathematical techniques involved in the hardware design of digital systems. Topics include: number systems and codes, Boolean algebra, Boolean functions, canonical forms, logic gate realization, universal gates, combinational and sequential circuits, and minimization of functions using Karnaugh maps, the Quine-McCluskey method and basic computer organization. Interactive circuit design software is used for laboratory experiments.

*Pre-requisite: CS 252*

**CS 265 UNIX Systems Programming**

3 credits; 3 class hours; 1 lab hour

This course provides an in-depth study in the programming of UNIX systems. Topics include: UNIX commands, the UNIX File System and its related structures, Editors, the UNIX Command Interpreter, System Administration, Shell Programming, UNIX Applications Operating Environments, communicating and networking through UNIX.

*Pre-requisite: CS 244*

**CS 278 Robot Programming**

3 credits; 3 class hours; 1 lab hour

This course provides a hands-on introduction to programming machines that interact with the real world using sensors, actuators, and limited computational resources. Physical robots are programmed to demonstrate "artificially intelligent" behavior by using sensors to watch for and react to changes in the physical world. A Survey of salient characteristics, including definition and structure, and specification of syntax and semantics, for graphical, text-based, object-oriented, and query robot programming languages is covered. Web-based distance-learning tools are used to introduce robot fundamentals and verify programs.

*Pre-requisite: CS 246***CS 280 Artificial Intelligence**

3 credits; 3 class hours; 1 lab hour

This course examines the ideas and techniques underlying the design of intelligent computer systems. Topics include knowledge representation, heuristic versus algorithmic search methods, problem solving, game playing, logical inference, planning, reasoning under uncertainty, expert systems, learning, perception, natural language understanding, and intelligent agents. A functional programming language appropriate to Artificial Intelligence will be introduced.

*Pre-requisites: CS 246 Data Structures and Algorithms***CS 300 Theoretical Computer Science**

3 credits; 3 class hours; 1 lab hour

This course focuses on fundamental issues of Computer Science Theory, Automata and Formal Language Theory, and the Theory of Computational Complexity. Topics include formal languages, finite state automata, pushdown automata, Turing machines and the languages they recognize. This course also examines computability by recursive functions, Church's Thesis, undecidability, the classes P and NP, NP-complete problems and intractable problems.

*Pre-requisite: CS 246 Data Structures and Algorithms and MTH 202 Calculus I***CS 301 Software Development**

3 credits; 2 class hours; 2 lab hours

This course provides an implementation-oriented introduction to the software-development techniques used to create medium-scale interactive applications. The capabilities of the Java programming language and its runtime environment are covered. Topics include:

1. Navigating the Java Class Libraries
2. Imperative and Object-oriented Programming
3. Exception Handling
4. Event Handling
5. Concurrency
6. Multithreading
7. Collections

8. Graphics

9. GUI programming and frame layout

10. Applets

11. Input/output and Networking with Java

*Pre-requisite: CS 246***CS 305/TLC305 Data Communications and Web Technologies**

3 credits; 4 class hours

This course is designed to provide the students with a fundamental technical and practical background in data communications with the context of network technologies. Topics include fundamental concepts of data communications; data transfer modes; the OSI model; transmission mediums and the physical layers; modems and modem standards; local area networks (LANs) and wide area networks (WANs); communications standards including communications codes, application support protocols, and network architecture; and intranet/Internet routers.

*Pre-requisites: CS 246 and TLC 221***CS 307/TLC 307 Local and Wide Area Networks**

3 credits; 2 class hours; 2 lab hours

This course covers computer network analysis and design and its applications. A variety of network topologies for centralized, decentralized and distributed networks will be discussed. Topics include LAN fundamentals, evaluating LAN cabling systems, switching techniques, routing algorithms, flow control, survey and comparison of existing commercial Local Area Networks. Students will learn to configure, install, operate, troubleshoot and administer networks.

*Co-requisite: CS 305 and TLC 305***CS 309/TLC 309 Network Programming**

3 credits; 2 class hours; 2 lab hours

This course focuses on interconnecting Local Area Networks (LAN) into larger private and public networks including Enterprise and Wide Area Networks (WAN). Topics include network programming with Sockets, TCP/IP protocol stack, server side/client side applications programming. Students will have the opportunity to take Microsoft, Novell and Netscape examinations towards \certification as Web Masters.

*Pre-requisites: CS 305 and TLC 305***CS 310 Special Topics in Computer Science**

3 credits 3 class hours

Courses on contemporary topics in computer science to be offered according to the latest developments in the field and the needs of the students. Students are taught the underlying principles of analysis, design, and implementation issues involved in computing. Several examples and applications are used to illustrate the theory and concepts covered. A detailed description for each special topic offering may be obtained in the Department office prior

to registration. Students are also required to submit a research paper on an approved topic.

*Pre-requisites: CS 246 and Permission of the Chairperson or Coordinator of Computer Science.*

### **CS 312 Analysis of Algorithms**

3 credits; 4 class hours

This course covers measuring algorithmic complexity (O-Notation); searching and sorting algorithms and their complexity; tree and graph algorithms and their complexity; classes of algorithms, such as divide-and-conquer, backtracking, greedy, probabilistic, etc. Computational complexity; the classes P and NP.

*Pre-requisites: CS 246 Data Structures and Algorithms*

### **CS 315 Operating Systems**

3 credits; 3 class hours; 1 lab hour

This course is an introduction to operating systems. Topics include task management and scheduling, process and data management, resource allocation, interrupts, time sharing, concurrent processing, linear and tree-structured address space, resource allocation for multiprogramming, and queuing and network control policies. This course includes several detailed case studies that covers today's most widely used single-user, multi-user, and network operating systems.

*Pre-requisite: CS 246 Data Structures and Algorithms*

### **CS 319/ENVS 319 Geographical Information Systems**

3 credits; 3 class hours; 1 lab hour

This course examines the automated systems for the capture, storage, retrieval, analysis and display of spatial data. Topics include automated geography, spatial analysis, map as model, GIS data structures, GIS data input, storage and editing, classification, statistical surfaces, spatial arrangements, cartographic modeling, output from analysis, and GIS design and implementation.

*Pre-requisite: CS 151*

### **CS 321 Remote Sensing: Computer Methods for Satellite Data Analysis**

3 credits; 2 class hours; 2 lab hours

This course emphasizes the scientific principles of satellite data analysis and efficiency of computer methods for carrying out this analysis and convert raw data into meaningful physical quantities. Topics include: concepts and systems, electromagnetic energy, photographs from aircraft and satellite, remote sensing in the visible and IR spectrum, active and passive remote sensing, thermal IR images, Earth resources, image processing and interpretation, meteorological, oceanographical and environmental applications, and monitoring natural hazards, geographic information system and overview of scatterometry. Course includes Hands-on demonstrations and data analysis of satellite data.

*Pre-requisite: CS 151*

### **CS 325 Computer Architecture**

3 credits; 3 lecture hours; 1 lab hour

Topics include instruction formats and addressing schemes, arithmetic and logic unit design, control unit design, main memory technology, virtual, high speed, associate and read only memories, programmable logic arrays, computer organization including stack, parallel and pipeline, and system structures: time sharing, multiprocessing and networking.

*Pre-requisite: CS 260 Digital Systems*

### **CS 345 Scientific Programming I: Data Analysis**

3 credits; 4 class hours

This course is an introduction to numerical algorithms for scientific computation. It covers basic concepts of numerical error, interpolation, quadrature, vectors and matrices, solution of linear systems of equations, non-linear equations. Computer implementation aspects are also investigated. Student programming applications will involve real-world datasets from NASA missions, EPA and NOAA using C++ and Java.

*Pre-requisite: CS 246*

### **CS 350 Programming Language Paradigms**

3 credits; 3 class hours; 1 lab hour

This course provides an overview of the key paradigms used in modern programming languages and illustrates those paradigms with several programming languages. It also provides sufficient formal theory to demonstrate the role of programming language design in the context of the general computer science research agenda.

*Pre-requisite: CS 246 Data Structures and Algorithms*

### **CS 360 Software Engineering**

3 credits; 3 class hours; 1 lab hour

This course introduces students to the phases, methodologies and tools involved in the software production process. Topics include the software life cycle, specifications and design, quality assurance and testing, maintenance as well as related economic aspects in the production of software. Students are also introduced to design and documentation tools utilized by software engineers and issues related to portability and reusability. The course is also an introduction to technical writing.

*Pre-requisite: CS 246*

### **CS 381 Database Systems**

3 credits; 3 class hours; 1 lab hour

This course provides the basis for a solid education in the fundamentals of database technology. Topics include Database Management, Database System Architecture, Relational Data Base Systems (Query Languages, Application Development Systems), Software Specific (Self Contained) and Hardware Specific (Data Base Machines). Data manipulation language studied include: SQL, relational calculus, Query-By-Example, and natural languages.

*Pre-requisite: CS 246*

**CS 390 Scientific Programming II: Modeling and Simulation**

3 credits; 4 class hours

Simulation of dynamic, physical systems using models involving numerical and logical processes. Modeling concepts, description in terms of entities, attributes, and activities, time flow mechanisms, queues, event-oriented vs. particle-oriented models. Collection and evaluation of statistics. Simulation languages. Computer projects using a general-purpose language (e.g. C++) and at least one simulation language (e.g. GPSS) will be assigned.

*Pre-requisite:* CS 345

**CS 392 Advanced Topics in Computer Science**

3 credits; 4 class hours

This course investigates the latest developments in the fields of Computer Science, Space Science, Earth Science and/or Environmental Science. Students are taught the underlying principles, data acquisition and analysis. Several examples and applications are used to illustrate the theory and concepts covered. A detailed description for each special topics offering may be obtained in the Department office prior to registration. Students are required to submit a research paper on an approved topic.

*Pre-requisite:* CS 345

**CS 401 Computer Science Internship/Research I**

3 credits; 6 class hours (minimum)

Students are required to participate in an internship or complete a significant research project during their senior year. This research and internship experience must involve project management: planning, scheduling, and production of a computing system. In addition to these technical skills, student should also develop an understanding of the social, ethical and economic considerations of project management. Students are required to attend weekly seminars, write an in-depth report, and give an oral presentation.

*Pre-requisites:* Permission of chairperson

**CS 402 Computer Science Internship/Research II**

3 credits; 6 class hours (minimum)

This course is a continuation of CS 401.

*Pre-requisites:* CS 401

**ENVS 200 Environmental Health Issues**

3 credits; 3 class hours

This course provides the basis for understanding the widespread health problems that are linked to environment and occupational concerns. Topics include the identity and sources of air and water pollutants, the spread of these pollutants, and the harmful effects of these pollutants. These responsibilities of those involved with public health and the measures private industry is taking in addressing environmental health concerns is discussed. Special

emphasis is given to health problems facing urban communities.

*Pre-Requisites:* Completion of math and language basic skills.

**ENVS 203 Environmental and Occupational Laws**

3 credits; 3 class hours

This course introduces the wide range of local, state, regional, federal, and international laws and regulations pertaining to environmental and occupational concerns. How the various governmental agencies interface is discussed, as well as compliance, violations, and penalties. This course also focuses on the federal environmental justice initiative.

*Pre-Requisites:* Completion of Math and Language basic skills.

**ENVS 301 Air, Water Pollution**

3 credits; 3 class hours

This course will provide a detailed outline of the sources and types of air pollutants and the ways in which these pollutants are dispersed. The course will also outline the established national goals for air and water quality needed to protect public health and welfare. This course will also address the topic of indoor air quality. This course will provide a more detailed treatment on the Clean Air Act, as amended, and the Clean Water Act as amended, to which students were previously introduced in the course entitled Environmental and Occupational Laws and Regulations (ENVS 200).

*Pre-Requisite:* CHM 201

**ENVS 302 Measurement and Instrumentation**

4 credits; 2 class hours; 6 lab hours

This course includes numerous laboratory exercises that familiarize students with methods of air, water and soil monitoring to determine the concentration levels of airborne, waterborne and soil contaminants. This course will stress the guidelines established by the New York City Department of Environmental Protection, the New York State Department of Environmental Protection, the Environmental Protection Agency and the National Institute for Occupational Safety and Health, for analyzing, documenting and reporting air and water pollutants. Instruments include HPLC, TOC, GC/MS, UV-vis-IR & AA spectrophotometry and FTIR.

*Pre-Requisites:* ENVS 301 and CHM 202

**ENVS 313 Waste Management**

3 credit; 3 class hours

The main objective of this course is to present a very detailed account on collection, treatment, and disposal of solid waste, waste water, and hazardous waste. The course will also draw attention to the improved technology on which the waste generator must rely as land becomes more limited and regulations increase. The course touches upon the causes and effects of the three basic types of waste; solid waste, waste water and hazardous waste. The treatment and reuse of water is also addressed. In the United States, the management of haz

ardous waste is significantly regulated. This course addresses the subjects of direct hazardous waste treatment, categorical remedial action requirements, and low level radioactive waste handling.

*Pre-Requisites:* CHM 201 and ENVS 200

#### **ENVS 400 Natural Resource, Conservation and Management**

3 credits; 3 class hours

This course is designed to provide the interdisciplinary perspective that is required for devising solutions to today's many natural resource management problems. This course will outline the efforts of Americans and people worldwide to conserve natural resources. The course also touches on the many successes and failures of policies, laws, organizations, conservation, and protection of our natural resources.

*Pre-Requisites:* ENVS 200 and ENVS 203

#### **ENVS 401 Ground Water**

3 credits; 3 class hours

This course will outline the scientific foundations for the study of groundwater and the technical foundations for the development of groundwater resources. The course will also address the subject of groundwater contamination and the growth of groundwater technology.

*Pre-Requisites:* MTH 204 and PHY 212

#### **ENVS 403 Field Study**

3 credit; 3 class hours

In this course students will be required to plan, complete and report on actual environmental projects. Environmental projects may be drawn from the following examples: the pollution beaches, parks and other recreational facilities in New York City and surrounding areas, illegal dump sites, the stock piles, and abandoned sites in New York City; the level of compliance of small businesses in central Brooklyn with federal, state, and local environmental and occupational laws; the effectiveness of New York City Department of Environmental Protection (DEP) in poor neighborhoods; pollution and contamination linked to businesses operation in central Brooklyn, and finally the compliance of area residents with new recycling laws. Students will be taught how to design and implement projects and how to prepare environmental reports. Three to four students will be assigned to each environmental project.

*Pre-Requisites:* ENVS 302 and ENVS 400

#### **ENVS 404 Internship**

3 credits; 3-6 class hours

For the final semester, students are required to work at least three hours per week with an environmental concern providing one of the following services: Air quality and Pollution Control, Energy Development, Conservation, and Recovery, Environmental and Ecology Studies, Environmental Impact Analyses, Facility Operation and Management, Hazardous and Toxic Waste Management, Industrial Waste Control and Treatment, Human Settlements and Environmental issues, Laboratory Services, Marine Waste Disposal and Nearshore Oceanography,

Regional Water Pollution Control Planning, Sewage Treatment and Disposal, Sludge Handling and Disposal, Solid Waste Management, Storm Drainage and Flood Control, Water Supply, Treatment and Distribution, and finally, Research.

*Pre-Requisite:* Approval by department.

#### **ENVS 405 Pollution Control and Prevention**

3 credits; 3 class hours

This course focuses on the rapidly developing new technology for the control of pollutants. It therefore provides very detailed discussion on such topics as source and emission controls. The course will draw attention to the following subjects: particulate and gas controls for stationary and mobile sources of air quality, and water treatment. The only effective way to prevent air pollution is to prevent the release of pollutants at the source. This course will outline modifications on combustion and the technology for the treatment of industrial exhaust gases before they are released into the atmosphere will also be addressed.

*Pre-Requisites:* ENVS 301 and ENVS 303

#### **Physical Science**

##### **PHS 101 Introduction to Physical Sciences**

3 credits; 3 class hours; 1 lab hour

This course is designed to study the basic laws that govern the universe and how these laws are revealed to us. The topics covered include motion, atoms energy, forces, the interaction of atoms, the physical properties of substances, and the study of objects in the universe. Laboratory exercises are an integral part. Lectures are supplemented by demonstrations and hands-on experiments. Visits to scientific museums and centers are required.

*Pre-requisites:* Completion Math and Language Basic Skills



**PHS 201 Research Methods and Laboratory Instrumentation**

2 credits; 3 class hours

This course is an introduction to the nature of scientific investigation and the skills needed to develop a research problem. Topics include the scientific process, research design, library and computer resources for literature review, analysis and presentation of data, use of computer for communications and data analysis, and the theory, design and operation of laboratory instrumentation.

*Co-requisite: CS 241 or CHM 201 or PHY 211*

**PHS 203 Atmospheric Science (Meteorology)**

3 credits; 4 class hours

This course is an introduction to the principles and phenomena of the atmosphere, weather and climate. Topics include clouds, sky color, greenhouse effect, precipitation, storms, hurricanes, storm tracks, climates and the Ice Ages, weather analysis and forecasting.

*Pre-requisites: PHY 212 and CHM 201*

**PHS 221 Introduction to Telecommunications**

3 credits; 3 class hours

This course is an introduction to the essentials of the transmission of information. Topics include historical development, basics of data transmission, audio, structural and pictorial information; use of computers in transmission, coding and decoding; technical aspects of cable, telephone, radio, television, satellite and fiber optics, storage and retrieval of data; computer networks, synchronous and asynchronous transmission, modems and interfaces, analog and digital switching.

*Pre-requisite: PHY 114 or CS 151*



**PHS 301 Special Topics in Climate and Planets**

3 credits; 3 class hours

This course examines topics of current interest in the field of atmospheric science and planetary sciences, which are not covered in the regular curriculum. Topics vary from semester to semester, and reflect the interest of students and faculty. The course description may be obtained in the department office prior to registration. Issues examined may include storms and storm tracking, cloud structures, planetary atmospheres, meteorology, fluid dynamics and turbulence, atmospheric environmental changes.

*Pre-requisites: PHY 212 and CHM 202*

**PHS 306 Hydrology**

3 credits; 3 class hours; 1 lab hour

This course emphasizes the interaction of various processes in the hydrologic cycle. Topics include precipitation, stream flow, evaporation, run-off, the occurrence of ground water, concepts of ground water flow, equations for ground water flow and an introduction to modeling ground water systems.

*Pre-requisite: PHY 212*

**PHS 331 Special Topics in Telecommunications**

3 credits; 3 class hours

This course covers contemporary topics in telecommunications to be offered according to the interest of faculty members and students. The course description may be obtained in the Department office prior to registration. Independent study and seminars are required. Students are also required to submit a paper on an approved topic.

*Pre-requisite: Permission of chairperson*

**PHY 351 Intermediate Electromagnetic Theory**

3 credits; 3 class hours; 1 lab hour

This course is a comprehensive study of electromagnetism.

Topics include:

1. electric field and potential
2. Gauss's law
3. electrostatic potential energy
4. Laplace equation
5. boundary value methods
6. electric dipoles and multipoles
7. electric fields in matter
8. dielectric theory
9. magnetic fields and vector potentials
10. Ampere's law
11. Faraday's law
12. inductance
13. electric fields from time-varying magnetic fields
14. magnetic fields in matter
15. Maxwell equations
16. Poynting's theorem
17. wave equation for vector and scalar potentials
18. plane wave propagation
19. waveguides

20. radiation

Co-requisite: MTH 205

Pre-requisite: PHY 303

**PHS 401/402/403 Independent Research I, II, III**

3 credits each; 9 class hours each

Students are engaged in a minimum of nine (9) hours of conference and independent research per week. Library and computer or laboratory investigation of a problem in the Physical Sciences, Computer Science or Environmental Sciences, which is selected by the Department and pursued under the guidance of a faculty mentor in the Department. Students will present research (oral and/or poster presentations) at Department, CUNY-Wide or national seminars; in addition students will submit a written report of the research carried out. Only three of these credits may be applied to the Bachelors degree.  
Pre-requisites: Completion of 48 Credits Towards degree, and Completion of Courses Appropriate to the Research Project as Determined by the faculty mentor and permission of chairperson

**PHY 114 Basic Physics**

3 credits; 3 class hours; 1 lab hour

This is a one semester survey course covering the fundamentals of Physics. Emphasis will be placed on the basic concepts and meaning of physical laws. Topics include force, vectors, velocity and acceleration, Newton's laws of motion, gravitation, work and energy, thermal energy, electrostatics, electric current, magnetism, atomic structure of matter, and wave phenomena.

Co-requisite: MTH 151

**PHY 150 Physics for Health Professions**

4 credits; 3 class hours; 3 lab hours

This is an introductory course for the health professions covering the fundamental principles of physics with applications to biological and physiological phenomena such as circulation, hearing, vision, bioelectricity, radiation and electronic instruments used in the medical field.

Pre-requisites: Math and Language Basic Skills

**PHY 205 Introduction to Physics I**

4 credits; 3 class hours; 3 lab hours

This is the introductory course in physics designed for students majoring in the biological sciences. The course includes the basic laws of mechanics, energy and momentum conservation, and thermal properties of matter.

Pre-requisites: MTH 151 and PHY 114

**PHY 206 Introduction to Physics II**

4 credits; 3 class hours; 3 lab hours

This is the continuation of the introductory course in physics designed for students majoring in the biological sciences. Topics include properties and propagation of sound, wave motion, light and fundamental concepts of electrical phenomena, electrostatics, electric circuits, electromagnet-

ism, and a.c. circuits.

Pre-requisite: PHY 205

**PHY 211 University Physics I**

4 credits; 4 class hours; 3 lab hours; 1.5 workshop hours

This course is the first part of the four semester calculus physics sequence. Topics include vectors, kinematics and dynamics of particles, work, energy conservation, linear and angular momentum conservation, rotational kinematics and dynamics, harmonic motion and fluid statics and dynamics.

Pre-requisite: PHY 114

Co-requisite: MTH 202

**PHY 212 University Physics II**

4 credits; 4 class hours; 2 lab hours; 1.5 workshop hours

This course is the second part of the four semester calculus physics sequence. Topics include gravitation, special relativity, heat, laws of thermodynamics, kinetic theory, entropy, plane and spherical waves, sound, geometric optics, light, interference, diffraction and polarization.

Pre-requisite: PHY 211

Co-requisite: MTH 203

**PHY 213 University Physics III**

4 credits; 4 class hours; 2 lab hours; 1.5 workshop hours

This course is the third part of the four semester calculus physics sequence. Topics include electrostatics, electric potential and fields, Gauss's law, dielectrics, current, moving charge, magnetic fields, circuits, fields in matter, Maxwell's equations, electromagnetic waves and spectrum.

Pre-requisite: PHY 211

Co-requisite: MTH 203

**PHY 303 Modern Physics**

3 credits; 4 class hours

This course is the final part of the four semester calculus physics sequence. Topics include special and general relativity, photoelectric effect, black-body radiation, quantum effects, Bohr atom model, quantum theory, many electron atom, X-rays, atomic spectra, nuclear structure, and nuclear reactions.

Pre-requisites: PHY 212 and PHY 213

Co-requisite: MTH 204

**PHY 304 Introduction to Quantum Mechanics**

3 credits; 4 class hours

This course is a continuation of PHY 303 covering the application of quantum mechanics to atomic and nuclear phenomena. Topics include wave functions and operators, solutions of Schroedinger's equation and perturbation theory.

Pre-requisite: PHY 303

**PHY 305 Intermediate Experimental Physics Laboratory**

2 credits; 4 lab hours

This is a laboratory course designed to introduce the experiments and techniques of Modern Experimental

Physics. Students have an option from a variety of experiments that they can pursue. Experiments involve the fields of atomic physics, nuclear physics, Doppler effect, gravitation, and electromagnetic theory.

Co-requisite: PHY 303

### PHY 309 Electronics

4 credits; 2 class hours; 4 lab hours

This course is an introduction to analog and digital electronics for students of the natural sciences with emphasis on modern electronic instrumentation. Experiments include use of function generators, power supplies, operational amplifiers, transducers, programmable analog switching, solid state amplifiers and switches, logic gates, flip-flops, latches, registers, counters, digital devices and signals, introduction to microcomputers, interfacing, microprocessors, and signal processing and noise reduction techniques.

Pre-requisite: PHY 213 or PHY 206

### PHY 315 Introduction to Astrophysics

3 credits; 4 class hours

This course is an introduction to modern astrophysical problems with an emphasis on the physical concepts involved: radio, optical and x-ray astronomy; the solar system; stellar structure and evolution; white dwarfs, pulsars and black holes; galactic structure and evolution, quasars; gravitation and cosmology.

Pre-requisite: PHY 303

### PHY 319 Thermodynamics and Statistical Physics

3 credits; 3 class hours; 1 recitation hour

This course is a comprehensive study of thermodynamics and statistical physics. Topics include equation of state, the gas laws, Laws of Thermodynamics, entropy and probability, Maxwell-Boltzmann Statistics, equipartition of

energy, quantum statistics and degenerate gases.

Pre-requisites: PHY 212, PHY 213 and CHM 202

**Note:** Course will be cross-listed with CHM 321 Physical Chemistry I

### PHY 329 Dynamics and Celestial Mechanics

3 credits; 3 class hours; 1 recitation hour

This course is a comprehensive study of classical dynamics of particles and systems. Topics include Newtonian mechanics of single particle, oscillations, nonlinear oscillations, gravitation, motion of moon and planets, Ergodic theorem, Kepler and elliptic motion, Euler's equation, Hamilton's principle, Lagrangian mechanics, Hamiltonian mechanics, central force motion, dynamics of a system of particles, motion in a noninertial reference system, rigid bodies, coupled oscillations, continuous systems and waves, special relativity theory..

Pre-requisites: PHY 212, PHY 213

### PHY 355 Gravitation and Cosmology

3 credits; 3 class hours; 1 recitation hour

This course is a comprehensive study of classical dynamics of particles and systems. Topics include Newtonian mechanics of single particle, oscillations, nonlinear oscillations, gravitation, motion of moon and planets, Ergodic theorem, Kepler and elliptic motion, Euler's equation, Hamilton's principle, Lagrangian mechanics, Hamiltonian mechanics, central force motion, dynamics of a system of particles, motion in a noninertial reference system, rigid bodies, coupled oscillations, continuous systems and waves, special relativity theory..

Pre-requisites: PHY 351 Intermediate Electromagnetic Theory or PHY 315 Astrophysics or MTH 324 Introduction to Differential Geometry or MTH 358 Differential Geometry and Relativity Theory



