North Carolina Agricultural & Technical State University

Bachelor of Science

in

Computer Science

Undergraduate Student Handbook

College of Engineering

Computer Science Department

3rd floor- Harold L. Martin Senior Engineering Research and Innovation Complex

(Last Curriculum Update- Fall 2023)

(Last Handbook Update Nov. 10, 2023)

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*Note: Required CS and Computer Programming Courses are shown on page 14 and the Prerequisites for CS elective courses are on page 19.

Introduction

This handbook provides information about the Bachelor of Science Degree in Computer Science at North Carolina A&T State University. This handbook serves as a guide to students majoring or interested in majoring in Computer Science. Please also see the North Carolina A&T State University Undergraduate Bulletin for general information concerning undergraduate students.

Vision

It is the vision of the Computer Science Department that we will produce high quality graduates who will be among the top professionals and researchers in the computing field, and who will be outstanding contributors in enhancing the quality of life for future generations.

Objectives

The objectives of the Department of Computer Science are to:
1. Provide high quality education in computer science through exemplary teaching, scholarly research, and public service, focused on preparing our student to be distinctive leaders and significant contributors to society.
2. Provide a broad base in the design, implementation, and application of computer software systems and a functional background in computer hardware systems. This primary objective strives to impart lasting theoretical concepts and fundamental skills to prepare the students for lifelong learning as well as to familiarize them with current technology.
3. Give the student the opportunity to develop a well-rounded background as an overall articulate individual by requiring study in written and oral communication, natural and social sciences, humanities and the arts, business, and economics, as well as promoting their participation in social and professional activities.
4. Prepare students for advanced scholarly endeavors in computer science.
5. Develop professional skills and work ethics (ethics in the workplace and the ethics of working hard).

The Computer Science Undergraduate Program Educational Objectives (PEO) are:

Each graduate of the program should be able to:

1. Perform effectively and remain effective through life-long learning in a computer science related career.

2. Perform effectively in graduate programs where an undergraduate degree in computer science is required.

3. Effectively communicate ideas and collaborate professionally with colleagues and clients.

The Computer Science Undergraduate Program enables students to achieve the following outcomes by the time of graduation:

1. Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

6. Apply computer science theory and software development fundamentals to produce computing-based solutions.

Accreditation

The Computer Science Bachelor of Science Program is accredited by the Computing Accreditation Commission (CAC) of ABET, http://www.abet.org.

Admission Policies

Actual admission into the Computer Science Undergraduate Program is coordinated through the NC A&T State University Admissions Office. Students must first apply to the University and support his/her application for admission with the following evidence of qualification in order to be considered for admission into the Computer Science Undergraduate Program:

For admittance to all undergraduate programs all freshman applicants must satisfy the following minimum high school course requirements for admission:
1. English – 4 units
2. Natural Sciences – 3 units: Biological science, Physical science, Science with a laboratory.
3. Social Sciences – 2 units: United States History is required as one of the social sciences.
4. Foreign Language – 2 units of the same.
5. Mathematics – 4 units: Algebra I, Geometry, Algebra II, and one of the following Advanced Mathematics courses:
   - Advanced Functions and Modeling
   - Discrete Mathematics
   - Pre-Calculus
   - Integrated Mathematics IV
   - AP Statistics
   - Essential for College Mathematics
   - AP Calculus A/B
   - AP Calculus B/C
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Additional criteria for acceptance into the **Computer Science Program** are a weighted minimum GPA of **3.0,** SAT Total (SATT) = **1080**; SAT Math (SATM) = **520 minimum**; or ACT Score = **21**; ACT Math (ACTM) = **21**.

Policy for Changing Major to Computer Science

If you are currently undecided or in another major at North Carolina A&T State University, and you wish to change your major to Computer Science, you must meet the following criteria:

1. Complete COMP 163: Introduction to Computer Programming with a grade of C or better.
2. Complete MATH 131: Calculus I with a grade of C- or better; or Complete COMP180.
3. Must have a cumulative grade point average of 2.5 or better.

Policy on Undergraduate Students Receiving Credit by Examination

The following is the procedure by which a student may receive credit by exam for undergraduate computer science courses.

1. A student wishing to receive credit by exam for any undergraduate course in computer science must be recommended by a faculty member who is very familiar with the course material.
2. To receive credit by exam for a course, the student must be registered for the course.
3. The student must take a comprehensive exam for the course and get 80% of the exam correct.
4. If a student passes the exam, the student will receive a grade of "P" for the course.
5. The student must take the exam no later than the first week of class.
6. A faculty member, who normally teaches the course, will provide and administer the exam.

Academic Integrity

Academic integrity is critical to maintaining high standards within the academic community. All students enrolled in the College of Engineering are expected to demonstrate academic integrity when submitting course-related work (e.g., assignments, quizzes, individual projects, and exams). Academic integrity violations, when submitting course-related work, will result in the loss of credit for the specific assignment, quiz, individual project or exam, or a grade of "F" for the course.

Repeated academic integrity violations may lead to dismissal from the University. To review the North Carolina A & T State University's Academic Dishonesty Policy, please see the following URL:

https://www.ncat.edu/campus-life/pdfs/2020-2021-student-handbook.pdf

(pp. 34-35)

Minimum Grade of "C" Policy

Students must earn a grade of "C" or better in the following courses to graduate (Computer Science students) or to satisfy prerequisite requirements of subsequent courses. **Note:** A grade of "C-" does not meet the minimum grade standard. Computer Science students must earn a grade of "C-" or better in MATH 131.

COMP163, COMP167, COMP280, COMP285

Curriculum Guide for a Bachelor of Science in Computer Science

Computer Science BS Curriculum (Starting Fall 2023)

Freshmen Year

Semester 1 (Fall) Courses		Semester 2 (Spring) Courses	
ENGL100 Ideas & Their Expressions I	3	ENGL101 Ideas & Their Expressions II	3
Social/Behavior Sciences Elective [1]	3	*Knowledge of African-American Culture and History* [1]	3
COMP163 Introduction to Computer Programming **(Formerly GEEN163)**	3	COMP167 Computer Program Design **(Formerly GEEN165)**	**3**
GEEN111 COE Colloquium	1	COMP 180 Discrete Structures	3
MATH131 Calculus I	4	MATH 132 Calculus II	4
COMP121 CS Freshmen Colloquium	1		
Total	15	Total	16

Sophomore Year

Semester 3 (Fall) Courses		Semester 4 (Spring) Courses	
SPCH 250 Speech Fundamentals (Humanities/Fine Arts)	**3**	*Global Awareness* [1]	3
Approved Science Elective [2]	4	Approved Science Elective [2]	4
Business Elective [3]	3	COMP 285 Design and Analysis of Algorithms	3
MATH 341 Diff. Equations	3	Approved Mathematics Elective [4]	3
COMP 280 Data Structures	3	COMP 267 Data Base Design	3
		COMP 200 Sophomore Colloquium	1
Total	16	Total	17

Junior Year

Semester 5 (Fall) Courses		Semester 6 (Spring) Courses	
Approve Science Elective [2]	4	ENGL331 Writing Science & Tech.	3
Approved Statistics Elective [5]	3	COMP322 Internet Systems	3
COMP360 Programming Languages	3	COMP365 Artificial Intelligence & Machine Learning	3
Approved Computer Architecture Elective [6]	3	COMP350 Operating Systems	3
Approved COMP Elective [7]	3	COMP410 Software Engineering	3
		COMP300 Junior Colloquium	1
Total	16	Total	16

Senior Year

Semester 7 (Fall) Courses		Semester 8 (Spring) Courses	
COMP385 Theory of Computing	3	COMP496 Senior Project II (Capstone)	3
COMP390 Soc. Implications of Computing (Ethics)	3	Approved COMP Elective [7]	3
COMP476 Networked Comp. Sys.	3	Approved COMP Elective [7]	3
COMP495 Senior Project I	3	Free Elective	3
Total	12	Total	12
TOTAL CREDIT	**120**		

[1] Select from the lists of electives for General Education Requirements (PP. 17 of this handbook).

[2] **Science Electives** - Take 12 hours from one of the following two groups: **Group 1:** CHEM106/116 and CHEM107/117 and [PHYS241/251 or BIOL100 or BIOL101 or SLMG200]; **Group 2:** PHYS241/251 and PHYS242/252 and [CHEM106/116 or BIOL100 or SLMG200]

[3] **Business Electives** - Take 3 hours from the following: MGMT 110, BUAN 132, MKTG 230, ECON200, or ECON201

[4] **Math Electives -** MATH 340 Numerical Methods *or* MATH351 Linear Algebra

[5] **Statistics Electives -** MATH 224 Probability & Statistics *or* ISEN 370 Eng. Statistics or ECEN 356 Stochastic Processes and Random Variables

[6] **Computer Architecture Electives** – COMP375 Computer Architecture and Organization or ECEN375 Computer Architecture and Organization

[7] **COMP Electives** - Take 9 hours from the approved Computer Science Electives, or [BUAN 335, ECEN 427, ISEN 415, MATH 365, CST 340]

Curriculum Guide for a BS in Computer Science (For students needing Pre-Calculus)

Computer Science BS Curriculum (Starting Fall 2023)			

Freshmen Year

Semester 1 (Fall) Courses		Semester 2 (Spring) Courses	
ENGL100 Ideas & Their Expressions I	3	ENGL101 Ideas & Their Expressions II	3
Social/Behavior Sciences Elective [1]	3	*Knowledge of African-American Culture and History* [1]	3
COMP163 Introduction to Computer Programming **(Formerly GEEN163)**	3	COMP167 Computer Program Design **(Formerly GEEN165)**	*3*
GEEN111 COE Colloquium	1	COMP 180 Discrete Structures	3
MATH110 Pre-Calculus	4	MATH131 Calculus I	4
COMP121 CS Freshmen Colloquium	1		
Total	15	Total	16

Sophomore Year

Semester 3 (Fall) Courses		Semester 4 (Spring) Courses	
SPCH 250 Speech Fundamentals (Humanities/Fine Arts)	*3*	*Global Awareness* [1]	3
Approved Science Elective [2]	4	Approved Science Elective [2]	4
Business Elective [3]	3	COMP 285 Design and Analysis of Algorithms	3
MATH 132 Calculus II	4	MATH 341 Diff. Equations	3
COMP 280 Data Structures	3	COMP 267 Data Base Design	3
		COMP 200 Sophomore Colloquium	1
Total	17	Total	17

Junior Year

Semester 5 (Fall) Courses		Semester 6 (Spring) Courses	
Approve Science Elective [2]	4	Approved Mathematics Elective [4]	3
Approved Statistics Elective [5]	3	COMP322 Internet Systems	3
COMP360 Programming Languages	3	COMP365 Artificial Intelligence & Machine Learning	3
Approved Computer Architecture Elective [6]	3	COMP350 Operating Systems	3
Approved COMP Elective [7]	3	COMP410 Software Engineering	3
		COMP300 Junior Colloquium	1
Total	16	Total	16

Senior Year

Semester 7 (Fall) Courses		Semester 8 (Spring) Courses	
COMP385 Theory of Computing	3	COMP496 Senior Project II (Capstone)	3
COMP495 Senior Project I	3	Approved COMP Elective [7]	3
COMP476 Networked Comp. Sys.	3	Approved COMP Elective [7]	3
COMP390 Soc. Implications of Computing (Ethics)	3	ENGL331 Writing Science & Tech	3
Total	12	Total	12
TOTAL CREDIT	**120**		

[1] Select from the lists of electives for General Education Requirements (PP. 17 of this handbook).
[2] Science Electives - Take 12 hours from one of the following two groups: **Group 1:** CHEM106/116 and CHEM107/117 and [PHYS241/251 or BIOL100 or BIOL101 or SLMG200]; **Group 2:** PHYS241/251 and PHYS242/252 and [CHEM106/116 or BIOL100 or SLMG200]
[3] Business Electives - Take 3 hours from the following: MGMT 110, BUAN 132, MKTG 230, ECON200, or ECON201
[4] Math Electives - MATH 340 Numerical Methods *or* MATH351 Linear Algebra
[5] Statistics Electives - MATH 224 Probability & Statistics *or* ISEN 370 Eng. Statistics or ECEN 356 Stochastic Processes and Random Variables
[6] Computer Architecture Electives – COMP375 Computer Architecture and Organization or ECEN375 Computer Architecture and Organization
[7] COMP Electives - Take 9 hours from the approved Computer Science Electives, or [BUAN 335, ECEN 427, ISEN 415, MATH 365, CST 340]

Curriculum Guide for a Bachelor of Science in Computer Science with Concentration in Cyber Security

Computer Science BS Curriculum (Starting Fall 2023)

Freshmen Year

Semester 1 (Fall) Courses		Semester 2 (Spring) Courses	
ENGL100 Ideas & Their Expressions I	3	ENGL101 Ideas & Their Expressions II	3
Social/Behavior Sciences Elective [1]	3	*Knowledge of African-American Culture and History* [1]	3
COMP163 Introduction to Computer Programming **(Formerly GEEN163)**	3	COMP167 Computer Program Design **(Formerly GEEN165)**	*3*
GEEN111 COE Colloquium	1	COMP 180 Discrete Structures	3
MATH131 Calculus I	4	MATH 132 Calculus II	4
COMP121 CS Freshmen Colloquium	1		
Total	15	Total	16

Sophomore Year

Semester 3 (Fall) Courses		Semester 4 (Spring) Courses	
SPCH 250 Speech Fundamentals (Humanities/Fine Arts)	*3*	*Global Awareness* [1]	3
Approved Science Elective [2]	4	Approved Science Elective [2]	4
Business Elective [3]	3	COMP 285 Design and Analysis of Algorithms	3
MATH 341 Diff. Equations	3	Approved Mathematics Elective [4]	3
COMP 280 Data Structures	3	COMP 267 Data Base Design	3
		COMP 200 Sophomore Colloquium	1
Total	16	Total	17

Junior Year

Semester 5 (Fall) Courses		Semester 6 (Spring) Courses	
Approve Science Elective [2]	4	ENGL331 Writing Science & Tech.	3
Approved Statistics Elective [5]	3	COMP410 Software Engineering	3
COMP360 Programming Languages	3	COMP365 Artificial Intelligence & Machine Learning	3
Approved Computer Architecture Elective [6]	3	COMP350 Operating Systems	3
COMP322 Internet Systems	3	**COMP320 Fundamentals of Cybersecurity**	3
		COMP300 Junior Colloquium	1
Total	16	Total	16

Senior Year

Semester 7 (Fall) Courses		Semester 8 (Spring) Courses	
COMP385 Theory of Computing	3	COMP496 Senior Project II (Capstone)	3
COMP390 Soc. Implications of Computing (Ethics)	3	Approved COMP Elective [7]	3
COMP495 Senior Project I	3	COMP476 Networked Comp. Sys	3
COMP420 Applied Network Security	3	Free Elective	3
Total	12	Total	12
TOTAL CREDIT	**120**		

[1] Select from the lists of electives for General Education Requirements (PP. 17 of this handbook).
[2] Science Electives - Take 12 hours from one of the following two groups: **Group 1:** CHEM106/116 and CHEM107/117 and [PHYS241/251 or BIOL100 or BIOL101 or SLMG200]; **Group 2:** PHYS241/251 and PHYS242/252 and [CHEM106/116 or BIOL100 or SLMG200]
[3] Business Electives - Take 3 hours from the following: MGMT 110, BUAN 132, MKTG 230, ECON200, or ECON201
[4] Math Electives - MATH 340 Numerical Methods *or* MATH351 Linear Algebra
[5] Statistics Electives - MATH 224 Probability & Statistics *or* ISEN 370 Eng. Statistics or ECEN 356 Stochastic Processes and Random Variables
[6] Computer Architecture Electives – COMP375 Computer Architecture and Organization or ECEN375 Computer Architecture and Organization
[7] COMP Elective - Take 9 hours from the approved Computer Science Electives, or [BUAN 335, ECEN 427, ISEN 415, MATH 365, CST 340]

Curriculum Guide for a Bachelor of Science in Computer Science with Cyber Security Certificate

Computer Science BS Curriculum (Starting Fall 2023)			

Freshmen Year

Semester 1 (Fall) Courses		Semester 2 (Spring) Courses	
ENGL100 Ideas & Their Expressions I	3	ENGL101 Ideas & Their Expressions II	3
Social/Behavior Sciences Elective	3	*Knowledge of African-American Culture and History*	3
COMP163 Introduction to Computer Programming **(Formerly GEEN163)**	3	COMP167 Computer Program Design **(Formerly GEEN165)**	*3*
GEEN111 COE Colloquium	1	COMP 180 Discrete Structures	3
MATH131 Calculus I	4	MATH 132 Calculus II	4
COMP121 CS Freshmen Colloquium	1		
Total	15	Total	16

Sophomore Year

Semester 3 (Fall) Courses		Semester 4 (Spring) Courses	
SPCH 250 Speech Fundamentals (Humanities/Fine Arts)	*3*	*Global Awareness*	3
Approved Science Elective [2]	4	Approved Science Elective [2]	4
Business Elective [3]	3	COMP 285 Deisgn and Analysis of Algorithms	3
MATH 341 Diff. Equations	3	Approved Mathematics Elective [4]	3
COMP 280 Data Structures	3	COMP 267 Data Base Design	3
		COMP 200 Sophomore Colloquium	1
Total	16	Total	17

Junior Year

Semester 5 (Fall) Courses		Semester 6 (Spring) Courses	
Approve Science Elective [2]	4	ENGL331 Writing Science & Tech.	3
Approved Statistics Elective [5]	3	COMP410 Software Engineering	3
COMP360 Programming Languages	3	COMP365 Artificial Intelligence & Machine Learning	3
Approved Computer Architecture Elective [6]	3	COMP350 Operating Systems	3
COMP322 Internet Systems	3	**COMP320 Fundamentals of Cybersecurity**	3
		COMP300 Junior Colloquium	1
Total	16	Total	16

Senior Year

Semester 7 (Fall) Courses		Semester 8 (Spring) Courses	
COMP385 Theory of Computing	3	COMP496 Senior Project II (Capstone)	3
COMP390 Soc. Implications of Computing (Ethics)	3	**Approved Cybersecurity Elective [7]**	3
COMP495 Senior Project I	3	**Approved Cybersecurity Elective [7]**	3
Approved Cybersecurity elective [7]	3	COMP476 Networked Comp. Sys.	3
Total	12	Total	12
TOTAL CREDIT	**120**		

[1] Select from the lists of electives for General Education Requirements (PP. 17 of this handbook).

[2] **Science Electives** - Take 12 hours from one of the following two groups: **Group 1:** CHEM106/116 and CHEM107/117 and [PHYS241/251 or BIOL100 or BIOL101 or SLMG200]; **Group 2:** PHYS241/251 and PHYS242/252 and [CHEM106/116 or BIOL100 or SLMG200]

[3] **Business Electives** - Take 3 hours from the following: MGMT 110, BUAN 132, MKTG 230, ECON200, or ECON201

[4] **Math Electives -** MATH 340 Numerical Methods *or* MATH351 Linear Algebra

[5] **Statistics Electives -** MATH 224 Probability & Statistics *or* ISEN 370 Eng. Statistics or ECEN 356 Stochastic Processes and Random Variables

[6] **Computer Architecture Electives** – COMP375 Computer Architecture and Organization or ECEN375 Computer Architecture and Organization

[7] **Cybersecurity Electives** - Take 9 hours from the following: COMP420 or CST315, COMP422 or COMP620, COMP423 or COMP621, ISEN380, CST326, ECEN452, ECEN421, ECEN 485, CRJS 485.

Undergraduate Certificate in Cybersecurity

The Undergraduate Certificate in Cybersecurity Program offered by the Computer Science Department provides the training needed to apply cybersecurity knowledge, techniques, and tools to protect an organization's information, computer networks and systems. This certificate is a multidisciplinary program designed for CS and non-CS undergraduates. The courses offered by the Departments of Computer Science, Industrial and System Engineering, Electrical and Computer Engineering and Computer Systems Technology support this certificate.

Certificate Course Requirements
This certificate requires four 3-credit courses: one required course and 3 elective courses.
- COMP 320 Fundamentals of Cybersecurity (Prerequisite: COMP 280 Data Structures)
- Elective Courses (Select 3 from the following)
    - ISEN 380 Information Technology for Industrial and Systems Engineers (Prerequisite: ISEN 162 or Computer Programming)
    - COMP 420 Applied Network Security or CST 315 Network Security for Information Technology Professionals (COMP 420 Prerequisite: COMP 280 or Permission of the instructor) (CST 315 Prerequisite: None)
    - COMP422 Information Privacy and Security (Prerequisite: COMP280 or Permission of the instructor)
    - COMP423 Web Security (Prerequisite: COMP280 or Permission of the instructor)
    - CST 326 Database Security (Prerequisite: CST 325 Computer Database Management II)
    - ECEN 452 Introduction to Wireless Communication (Prerequisite: ECEN 400 Linear Systems and Signals)
    - ECEN 421 Embedded Systems (Prerequisites ECEN 427 Introduction to Microprocessors)
    - ECEN 485 Android Application Development (Prerequisite: Permission of the instructor)
    - CRJS 485 Special Topics in Criminal Justice. Cybercrime and Investigation
    - COMP 620 Information Security and Privacy (Prerequisite: GPA of 3.25 or above)
    - COMP 621 Web Security (Prerequisite: GPA of 3.25 or above)

Applying to the Certificate Program
A student interested in this program must submit an application form, a certificate plan of study, and a current transcript to the program coordinator.

Earning the Certificate
- Complete four three-credit certificate courses
- Earn at least a C grade in each course ("C- "does not meet the minimum requirement)

Curriculum Guide for a Bachelor of Science in Computer Science with Concentration in Health Informatics Security & Privacy

Computer Science BS Curriculum (Starting Fall 2023)			

Freshmen Year

Semester 1 (Fall) Courses		Semester 2 (Spring) Courses	
ENGL100 Ideas & Their Expressions I	3	ENGL101 Ideas & Their Expressions II	3
Social/Behavior Sciences Elective [1]	3	*Knowledge of African-American Culture and History* [1]	3
COMP163 Introduction to Computer Programming **(Formerly GEEN163)**	3	COMP167 Computer Program Design **(Formerly GEEN165)**	**3**
GEEN111 COE Colloquium	1	COMP 180 Discrete Structures	3
MATH131 Calculus I	4	MATH 132 Calculus II	4
COMP121 CS Freshmen Colloquium	1		
Total	15	Total	16

Sophomore Year

Semester 3 (Fall) Courses		Semester 4 (Spring) Courses	
SPCH 250 Speech Fundamentals (Humanities/Fine Arts)	***3***	*Global Awareness* [1]	3
Approved Science Elective [2]	4	Approved Science Elective [2]	4
Business Elective [3]	3	COMP 285 Design and Analysis of Algorithms	3
MATH 341 Diff. Equations	3	Approved Mathematics Elective [3]	3
COMP 280 Data Structures	3	COMP 267 Data Base Design	3
		COMP 200 Sophomore Colloquium	1
Total	16	Total	17

Junior Year

Semester 5 (Fall) Courses		Semester 6 (Spring) Courses	
Approve Science Elective [2]	4	ENGL331 Writing Science & Tech.	3
Approved Statistics Elective [5]	3	COMP322 Internet Systems	3
COMP360 Programming Languages	3	COMP365 Artificial Intelligence & Machine Learning	3
Computer Architecture Elective [6]	3	COMP350 Operating Systems	3
COMP 323 Introduction to Healthcare Information Systems	3	COMP410 Software Engineering	3
		COMP300 Junior Colloquium	1
Total	16	Total	16

Senior Year

Semester 7 (Fall) Courses		Semester 8 (Spring) Courses	
COMP385 Theory of Computing	3	COMP496 Senior Project II (Capstone)	3
COMP495 Senior Project I	**3**	**MGMT 485 MIS Special Topics**	3
COMP476 Networked Comp. Sys.	3	**MATH 310 MATH for Health Informatics**	3
Cybersecurity Elective [7]	3	COMP390 Soc. Implications of Computing (Ethics)	3
Total	12	Total	12
TOTAL CREDIT	**120**		

[1] Select from the lists of electives for General Education Requirements (PP. 17 of this handbook).
[2] Science Electives - Take 12 hours from one of the following two groups: **Group 1:** CHEM106/116 and CHEM107/117 and [PHYS241/251 or BIOL100 or BIOL101 or SLMG200]; **Group 2:** PHYS241/251 and PHYS242/252 and [CHEM106/116 or BIOL100 or SLMG200]
[3] Business Electives - Take 3 hours from the following: MGMT 110, BUAN 132, MKTG 230, ECON200, or ECON201
[4] Math Electives - MATH 340 Numerical Methods *or* MATH351 Linear Algebra
[5] Statistics Electives - MATH 224 Probability & Statistics *or* ISEN 370 Eng. Statistics or ECEN 356 Stochastic Processes and Random Variables
[6] Computer Architecture Electives – COMP375 Computer Architecture and Organization or ECEN375 Computer Architecture and Organization
[7] Cybersecurity Electives - COMP320 Fundamentals of Cyber Security *or* COMP420 Applied Network Security *or* COMP422 Information Privacy and Security or COMP423 Web Security

Computer Science Curriculum Guide for NC Community College Transfers

FALL SEMESTER

Freshmen Year

1st SEMESTER			
NCA&TSU Course		CC Course	CH
ENGL 100	Ideas & Their Expressions	ENG 111	3
MATH 131	Calculus I	MAT 271	4
Elective	Social/Behavioral Science Elective	CC Equiv.	3
COMP 163	Intro to Computer Programming	CSC 151	3
GEEN 111	College of Engineer Colloquium I [3]		1
COMP 121	Comp Science Freshman Colloq. [3]		1
	Total		15

SPRING SEMESTER

2nd SEMESTER			
NCA&TSU Course		CC Course	CH
ENGL 101	Ideas & Their Expressions	ENG 112	3
MATH 132	Calculus II	MAT 272	4
COMP 180	Discrete Structures	MAT 167	3
COMP 167	Computer Programming Design	CSC251	3
Elective	Knowledge of African Culture and History	CC Equiv.	3
	Total		16

Sophomore Year

3rd SEMESTER			
NCA&TSU Course		CC Course	CH
Elective	Business Elective	BUS 110	3
Elective	Approved Science Elective [1]	CC Equiv.	4
SPCH 250	Speech Fundamentals (Humanities/Fine Arts)	COM 110	3
MATH 341	Differential Equations	MAT 285	3
COMP 280	Data Structures	CSC 249	3
	Total		16

4th SEMESTER			
NCA&TSU Course		CC Course	CH
Elective	Global Awareness	CC Equiv.	3
Elective	Approved Science Elective [1]	CC Equiv.	4
COMP 285	Design and Analysis of Algorithms		3
Elective	Approved Math Elective	MAT 280	3
COMP 267	Data Base Design	DBA 115	3
COMP 200	Sophomore Colloquium		1
	Total		17

Junior Year

5th SEMESTER			
NCA&TSU Course		CC Course	CH
Elective	Approved Science Elective [1]	CC Equiv.	4
Elective	Approved Statistics Elective	MAT 152	3
COMP 360	Programming Languages		3
Elective	Computer Architecture Elective		3
Elective	Approved COMP Elective [2]		3
	Total		16

6th SEMESTER			
NCA&TSU Course		CC Course	CH
ENGL 331	Writing Science & Technology		3
COMP 322	Internet Systems		3
COMP 365	AI & Machine Learning.		3
COMP 350	Operating Systems		3
COMP 410	Software Engineering		3
COMP 300	Junior Colloquium		1
	Total		16

Senior Year

8th SEMESTER			
NCA&TSU Course		CC Course	CH
COMP 496	Senior Project II (Capstone)		3
Elective	Approved COMP Elective		3
Elective	Approved COMP Elective		3
Elective	Free Elective	CC Equiv.	3
	Total		12

7th SEMESTER			
NCA&TSU Course		CC Course	CH
COMP 385	Theory of Computing		3
COMP 495	Senior Project I		3
COMP 476	Networked Computer Systems	NET 110+125 or CTI 120	3
COMP 390	Soc. Implications of Comp. (Ethics)	CTS 210 or HUM110	3
	Total		12

TOTAL CREDITS = 120

Notes:
[1] Take 12 hours from one of the following two groups: Group 1: CHM 151 and CHM 152 and [PHY 251 or BIO 110 or BIO 111]; Group 2: PH 251 and PHY 252 and [CHM 151 or BIO 110]
[2] Cybersecurity COMP Electives from NC Community Colleges – NOS 244 or SEC 110 or SEC 150 or SEC 160
[3] Course substitutions will be made for GEEN 111 for students with 16 hours of transfer credits and for COMP 121 for those with 32 credit hours of transfer credits.

June 15, 2016

Minor in Computer Science

The Computer Science Minor program is designed to meet the growing demand for professionals with computing knowledge and skills. This program provides the training needed to apply computer science knowledge, techniques and tools to produce computing-based solutions. Students who have completed a minimum of 24 semester hours with a minimum GPA of 2.5 may elect to declare the minor. The declaration or change of a minor must be completed in the Office of the Registrar.
Students should have taken MATH131 with a grade of C- or better, and have taken COMP180 or MATH 123 or ECEN 227.

The Computer Science Minor requires six 3-credit courses: four required course and
2 elective courses.
• Required courses
  - COMP 163 Introduction to Computer Programming
  - COMP 167 Computer Program Design (Prerequisite: COMP 163)
  - COMP 280 Data Structures (Prerequisite: COMP167 and (MATH 123 or COMP 180 or ECEN 227)
  - COMP 285 Design and Analysis of Algorithms (Prerequisite: COMP 280, MATH 131)
• Two Elective courses (any 200, 300, or 400 level 3-credit hour computer science courses, or MATH 360, MATH 365, and CST 340).

Required Computer Science & Computer Programming Courses

GEEN 111	College of Engineering Colloquium	1
COMP 121	Computer Science Freshmen Colloquium	1
COMP 163	Introduction to Computer Programming	3
COMP 167	Computer Programming Design	3
COMP 180	Discrete Structures	3
COMP 267	Data Base Design	3
COMP 200	Computer Science Sophomore Colloquium	1
COMP 280	Data Structures	3
COMP 285	Design and Analysis of Algorithms	3
COMP 300	Computer Science Junior Colloquium	1
COMP 322	Internet Systems	3
COMP 350	Operating Systems	3
COMP 360	Principles of Programming Languages	3
COMP 365	Artificial Intelligence & Machine Learning	3
COMP/ECEN 375	Computer Architecture and Organization	3
COMP 385	Theory of Computing	3
COMP 390	Social Implications of Computing	3
COMP 410	Software Engineering	3
COMP 476	Networked Computer Systems	3
COMP 495	Senior Project I	3
COMP 496	Senior Project II	3
COMP	Computer Science Elective	9
	Total	**58**

Computer Science Electives

COMP 320	Fundamentals of Cybersecurity
COMP 321	Computer System Security
COMP 323	Introduction to Health Care Information Systems
COMP 340	Game Intelligence
COMP 356	Computational Hip-Hop & Object-Oriented Design
COMP 361	Data Analytics in Python
COMP 363	Object Oriented Programming
COMP 368	Object Oriented Software Design
COMP 420	Applied Network Security
COMP 421	Security Management for Information Systems
COMP 422	Information Privacy and Security
COMP 423	Web Security
COMP 440	Game Design
COMP 454	Virtual and Augmented Reality
COMP 469	Introduction to Parallel Programming
COMP 494	Independent Study
COMP 411	Introduction to System Testing and Evaluation
COMP 452	Network Science
COMP 453	Introduction to Computer Graphics
COMP 463	Introduction to Compiler Design
COMP 468	Introduction to Data Mining
COMP 485	Special Topics in Computer Science

COMP 600 level courses may be used as COMP Electives for students with senior standing

Computer Science Electives Offered in other Departments

BUAN 335	Management of Information Resources *(Formerly MGMT 335, MIS 440)*
ECEN 427	Introduction to Microprocessors
ISEN 415	Discrete Event Systems Model Simulation
MATH 365	Introduction to Data Science *(Formerly MATH465)*
CST 340	Introduction to Mainframe Operations

Mathematics

COMP 180	Discrete Structures	3
MATH 131	Calculus I	4
MATH 132	Calculus II	4
MATH 341	Differential Equations	3
MATH 224	Statistics and Probability *or* ISEN 270 Engineering Statistics *or* ECEN356 Stochastic Processes and Random Variables	3
MATH 340	Numerical Methods *(formerly MATH440)* *or*	
MATH 351	Linear Algebra *(Formerly MATH450)*	3
	Math total	**20**

Science

Take any one of the following groups:

Group 1

CHEM 106	Chemistry I with CHEM 116 lab	4
CHEM 107	Chemistry II with CHEM 117 lab	4

And any one course from the list below

PHYS 241	Physics I with PHYS 251 lab	4
BIOL 100	Biological Science	4
BIOL 101	Concepts of Biology	4
SLMG 200	Soil Science *(Formerly SLSC 338)*	4

Group 2

PHYS 241	Physics I with PHYS 251 lab	4
PHYS 242	Physics II with PHYS 252 lab	4

And any one course from the list below

BIOL 100	Biological Science	4
CHEM 106	Chemistry I with CHEM 116 lab	4
SLMG 200	Soil Science *(Formerly SLSC 338)*	4
	Science total	**12**

Business & Economics Group Electives

Choice one of the following:

MGMT 110	Business Environment *(formerly MGMT220)*
BUAN 132	Introduction to Management Information Systems *(formerly MIS 241)*
MKTG 230	Marketing *(formerly MKTG 430)*
ECON 200	Principles of Economics (Micro)
ECON 201	Principles of Economics (Macro)

General Education Requirements

ENGL100	Ideas & Their Expressions I	3
ENGL 101	Ideas & Their Expressions II	3
*SPCH250	Speech Fundamentals (Humanities/Fine Arts Elective)	3
*Social/Behavior Sciences Elective		3
*Knowledge of African-American Culture and History Elective		3
*Global Awareness Elective		3
ENGL 331	Technical Writing	3
Approved Business Electives		3
Free Electives		6
General Education Total		**30**

See table below.

Electives for General Education Requirements

Social/Behavior Sciences Elective, Knowledge of African-American Culture and History Elective, and Global Awareness Elective must be selected from the lists in this table to satisfy General Education Requirements.

HUMANITIES AND FINE ARTS ELECTIVES

- ENGL 200: Survey of Humanities I
- ENGL 201: Survey of Humanities II
- ENGL 230: World Literature I
- ENGL 231: World Literature II
- ENGL 211: Survey of African American Literature I (formerly ENGL 333)
- ENGL 212: Survey of African American Literature II (formerly ENGL 334)
- LIBS 202: Introduction to African American Studies
- MUSI 216: Music Appreciation
- MUSI 220: History of Black Music in America
- PHIL 101: Introduction to Philosophy (formerly PHIL 260)
- PHIL 103: World Religions (formerly PHIL 265)
- PHIL 104: Introduction to Ethics (formerly PHIL 268)
- PHIL 201: Business Ethics (formerly PHIL 315)
- PHIL 266: Contemporary Moral Problems
- PHIL 267: Philosophy of Love and Friendship
- SPCH 250: Fundamentals of Speech Communication

KNOWLEDGE OF AFRICAN AMERICAN CULTURE AND HISTORY

- ENGL 211: Survey of African American Literature I (formerly ENGL 333)
- ENGL 212: Survey of African American Literature II (formerly ENGL 334)
- HIST 103: NC A&T State University History: A Legacy of Social Activism and Aggie Pride (formerly HIST 203)
- HIST 106: African American History to 1877 (formerly HIST 201)
- HIST 107: African American History 1877 to the Present (formerly HIST 202)
- LIBS 202: Introduction to African American Studies
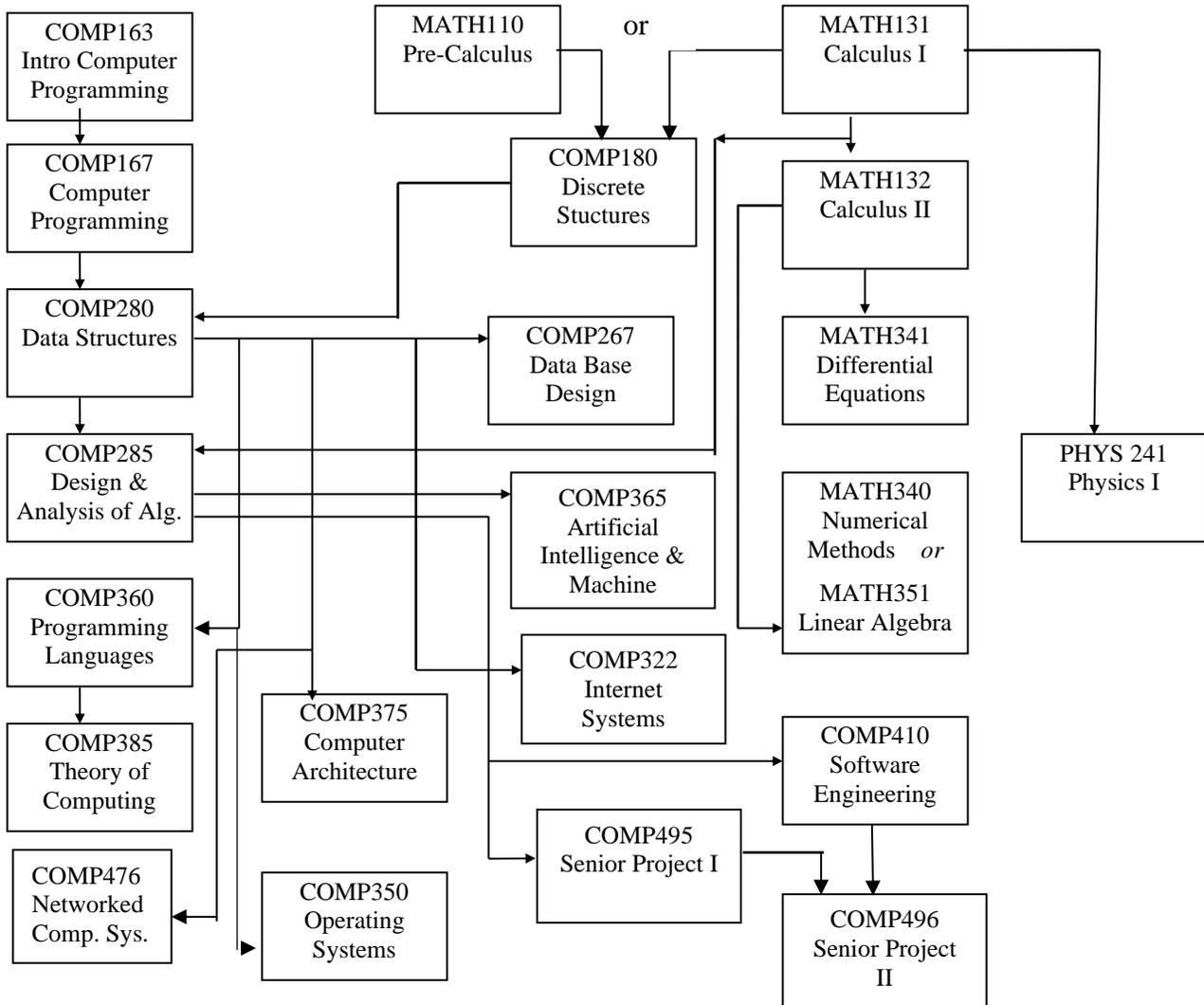- MUSI 220: History of Black Music in America

SOCIAL AND BEHAVIORAL SCIENCES ELECTIVES

- FIN 279: Personal Finance (formerly BUED 279 & BUED 379)
- ECON 200: Introductory Microeconomics
- ECON 201: Introductory Macroeconomics
- FCS 135: Food and Man's Survival
- FCS 181: Social-Psychological Aspects of Dress
- FCS 260: Introduction to Human Development
- HIST 103: NC A&T State University History: A Legacy of Social Activism and Aggie Pride (formerly HIST 203)
- HIST 104: U.S. History from 1492-1877 (formerly HIST 204)
- HIST 105: U.S. History from 1877-Present (formerly HIST 205)
- HIST 106: African American History to 1877 (formerly HIST 201)
- HIST 107: African American History 1877 to the Present (formerly HIST 202)
- HIST 130: The World Since 1945
- HIST 206: Pre-Modern World History
- HIST 207: Modern World History
- HIST 216: African History Since 1800
- HIST 231: Genocide
- JOMC 240: Media History
- POLI 110: American Government and Politics (formerly POLI 200)
- PSYC 101: General Psychology for Non-Majors (formerly PSYC320)
- SOCI 100: Principles of Sociology
- SOCI 200: Introduction to Anthropology
- SSFM 226: A Personal Approach to Health

GLOBAL AWARENESS

- HIST 130: The Contemporary Global Experience
- HIST 206: Pre-Modern World History (formerly HIST 100)
- HIST 207: Modern World History (formerly HIST 101)
- HIST 216: African History Since 1800
- HIST 231: Genocide
- MGMT 221: Global Business Environment
- PHIL 103: World Religions (formerly PHIL 265)
- PHIL 201: Business Ethics (formerly PHIL 315)

Prerequisites for Computer Science Required Courses

COMP163 Intro Computer Programming	MATH110 Pre-Calculus or	MATH131 Calculus I	
COMP167 Computer Programming	COMP180 Discrete Stuctures	MATH132 Calculus II	
COMP280 Data Structures	COMP267 Data Base Design	MATH341 Differential Equations	
COMP285 Design & Analysis of Alg.	COMP365 Artificial Intelligence & Machine	MATH340 Numerical Methods *or* MATH351 Linear Algebra	PHYS 241 Physics I
COMP360 Programming Languages	COMP322 Internet Systems		
COMP385 Theory of Computing	COMP375 Computer Architecture	COMP410 Software Engineering	
COMP476 Networked Comp. Sys.	COMP350 Operating Systems	COMP495 Senior Project I	COMP496 Senior Project II

Prerequisites for Computer Science Elective Courses

Course	Prerequisite
COMP 320 Fundamentals of Information Assurance	Junior Standing
COMP 321 Computer System Security	COMP285
COMP 323 Introduction to Health Care Information Systems	Junior Standing
COMP 340 Game Intelligence	COMP280
COMP 356 Computational Hip-Hop and OOD	COMP163 or Instructor's Permission
COMP 361 Data Analytics in Python	COMP280, MATH351, Statistics Electives
COMP 363 Object Oriented Programming	COMP280
COMP 368 Object-Oriented Software Development	COMP280
COMP 420 Applied Network Security	COMP280 or Instructor's Permission
COMP 421 Security Management for Information Systems	COMP285
COMP 422 Information Privacy and Security	COMP280 or Instructor's Permission
COMP 423 Web Security	COMP280 or Instructor's Permission
COMP 440 Game Design	COMP285
COMP 454 Virtual and Augmented Reality	COMP280
COMP 469 Introduction to Parallel Programming	COMP350 or Instructor's Permission
COMP 494 Independent Study	Instructor's Permission
COMP 411 Introduction to System Testing and Evaluation	COMP410
COMP 452 Network Science	COMP285
COMP 453 Introduction to Computer Graphics	COMP285
COMP 463 Introduction to Compiler Design	COMP285 and COMP375
COMP 468 Introduction to Data Mining	COMP280 or Instructor's Permission
COMP 485 Special Topics in Computer Science	Instructor's Permission

Course Descriptions

GEEN 111. College of Engineering Colloquium   **Credit 1(1-0)**
This course provides the students with exposure to current issues in computer science. Colloquium speakers shall include visitors and faculty.
Prerequisite: Freshman standing. **(F)**

COMP 120. Computers and Their Use   **Credits 3(2-2)**
This Course provides a survey of the basic principles of computer hardware, computer communications, application software, operating systems, security, impact on society, use in organizations and systems development. Principles of programming are introduced. Information is at a level for the students to become informed users. This course cannot be taken for credit by computer science majors. Prerequisite: None. **(F;S;SS)**

COMP 121. Computer Science Freshmen Colloquium   **Credits 1(1-0)**
This course includes lectures, seminars and activities important to the retention and matriculation of computer science students. Topics covered include learning styles, group dynamics, computer science history, and career development. Students are also provided with group advisement regarding department, college, and university-level policies and procedures. Prerequisite: None **(F;S;SS)**

COMP 160. C++ Programming for Engineers (Formerly GEEN160)   **Credits 3(2-2)**
This is an introductory course in C++ computer programming for engineering students. Problem solving techniques and coding algorithms will be stressed. Students will write programs for such tasks as engineering decision-making and numerical computation. Material relevant to the Fundamentals of Engineering exam will be covered. **(F;S;SS)**

COMP 161. Python for Data Science   **Credits 3(2-2)**
This course teaches the Python programming language along with an environment and standards that encourage efficient production of well-developed code. The course addresses numerical computing, data manipulation and analysis, plotting and visualization, machine learning, and language processing by focusing on the most important Python libraries (e.g., NumPy, pandas, Matplotlib, ggplot2, statsmodels, scikit-learn and NLTK) that enable the student to dao data science effectively using Python. Prerequisite: None **(F;S;SS)**

COMP 163. Introduction to Computer Programming (Formerly GEEN163)   **Credits 3(2-2)**
This is an introductory course in computer programming. Problem solving techniques and writing algorithms will be stressed. Students will write programs for such tasks as engineering decision-making and numerical computation. Prerequisite: None **(F;S;SS)**

COMP 167. Computer Program Design   (Formerly GEEN165)   **Credits 3(2-3)**
This is a second course in computer programming for students with an interest in computers. Students will learn to write programs in a high-level programming language. Prerequisite COMP163 **(F;S;SS)**

COMP 170. Introduction to Web Engineering   **Credits 4(3-2)**
This course introduces basic web development using HTML and client-side and server-side scripting. Students also learn how to incorporate security features into web sites as well as how to access and manage online databases. This course also covers the role of the web in disseminating knowledge, community formation, training, collaboration, and other social activities. Prerequisite: None **(F;S;SS)**

COMP 180. Discrete Structures   **Credits 3(3-0)**
Students will be introduced to formal systems, including propositional and predicate logic, that can be used to

reason about computer algorithms. Students will develop an understanding of how to read and construct valid proofs of the properties of algorithms. Important discrete data structures, such as sets, relations, discrete functions, graphs and trees, will be introduced. Prerequisite: MATH110 or MATH131 **(F;S;SS)**

COMP 200. Computer Science Sophomore Colloquium   Credit 1(1-0)
This course provides the students with exposure to current issues in computer science. Colloquium speakers shall include visitors and faculty. Prerequisite: Sophomore Standing **(F;S;SS)**

COMP 267. Database Design (Formerly COMP467)   Credits 3(3-0)
This course focuses on logical and physical organizations of sets of related data. It covers issues in file structures as well as file and database management systems. It explores relational models, hierarchical models, directed graph models, data definition and manipulation languages, and relational calculus. Application oriented projects are required. Prerequisite: COMP 280. **(F;S)**

COMP 280. Data Structures   Credits 3(3-1)
This is the third course in the computer science sequence. It introduces abstractions (algorithm, data type, complexity) and programming tools (pointers, dynamic memory, and linked data lists, and graphs). It analyzes and implements techniques such as hashing, sorting, searching, and priority queues, to solve general problems. The emphasis of the course is on building modular programs that can be changed to use different data structures and algorithms. Prerequisites: COMP 167 and (MATH 123 or COMP 180 or ECEN227). **(F;S;SS)**

COMP 285. Design and Analysis of Algorithms   Credits 3(3-0)
This course covers analysis of efficient algorithms for sorting, searching, dynamic structure manipulation, path finding, fast multiplication, and other problems. It introduces algorithmic techniques such as recursion, divide-and-conquer, and dynamic programming. It develops the following tools for algorithmic analysis: correctness proofs, algorithm synthesis, and discusses issues in non-computability. This course also overviews non-deterministic algorithms, and develops techniques to classify computationally hard problems. The concept of non-deterministic polynomial (NP)-completeness is introduced, and basic issues related to NP-completeness are discussed. Prerequisites: COMP 280, MATH 131. **(F;S;SS)**

COMP 300 Computer Junior Colloquium   Credit 1(1-0)
This course provides the students with exposure to current issues in computer science. Colloquium speakers shall include visitors and faculty. Prerequisite: Junior standing **(F;S;SS)**

COMP 320. Fundamentals of Cybersecurity   Credits 3(3-0)
This course covers concepts in computer network and information security. Topics include: software strategies for exchanging secure data and encryption standards. Strategies for the physical protection of information assets are explored. Issues involving information security management within an enterprise are covered, including suitable organizational policy, plans, and implementation strategies. Ethical issues, such as monitoring employee computer use and proper limitations on the use of customer data, are also discussed. (F;S;SS)

COMP 321. Computer System Security   Credits 3(3-0)
This course introduces the principles of information systems security and examines security policies, models, mechanisms for secrecy, integrity, availability and access controls. Topics include common system vulnerabilities and countermeasures, data availability and usage control, authentication technologies, design secure systems, operating systems security, network security, programming language security, and distributed systems security. Prerequisite: COMP285 (F;S;SS)

COMP 322. Internet Systems   **Credits 3(3-0)**
This course addresses the structure and functionality of the Internet and software that exploits it. Topics include markup languages, Web tools, static, dynamic and active web pages, multimedia in Web applications, communication protocols, client-server, computing, scripting, group and coordinating work at different sites, multi-agent systems that exploit the Internet, and architectures to exploit the distributed computational power offered by the Internet. Prerequisite: COMP 280 **(F;S;SS)**

COMP 323. Introduction to Health Care Information Systems   **Credits 3(3-0)**
This course introduces broad aspects of health care information systems. The goal is to prepare students with knowledge for effectively managing health care information systems. The main topics of this class include: types of health care information and data, regulations, standards, and laws of health care information, history of health care information systems, technologies in health care information systems, health care information systems standards, security in health care information systems, management of health care information systems. Prerequisite: Junior Standing **(F;S;SS)**

COMP 340. Game Intelligence   **Credits 3(3-0)**
This course provides an overview of concepts used in game intelligence. Topics will include intelligent game agents, game state representation, search, and machine learning.   Prerequisite: COMP280 **(F;S;SS)**

COMP 350. Operating Systems   (Formerly COMP450)   **Credits 3(3-0)**
This is an introduction to the theory and practice of operating system design and implementation. Algorithmic techniques are presented for implementing process management, storage management, processor management, file systems, security, distributed systems, performance evaluation, and real time systems. Prerequisite: COMP 280. **(F;S)**

COMP 356. Computational Hip-Hop and Object-Oriented Design   **Credits 3(3-0)**
This course introduces students to the fundamentals of the Unified Modeling Language (UML) from a Hip-Hop perspective. Students will learn how to use UML to reverse and forward engineer design artifacts for Hip-Hop music, and software applications.   Prerequisite: COMP163 or Instructor's Permission **(F;S;SS)**

COMP 360. Programming Languages   **Credits 3(3-0)**
This course focuses on formal specification of programming languages, including definition of syntax and semantics: simple statements including precedence, infixes, prefix, and postfix notations. It highlights global properties of algorithmic languages including sequence control, data structure implementation, scooping, storage management, grouping of statements, binding time, sub-routines, and tasks. Prerequisite: COMP 280 **(F;S;SS)**

COMP 361. Data Analytics in Python   **Credits 3(3-0)**
This course teaches how to develop efficiently well-designed, well-documented, tested, and integrated Python code for users to solve problems in data analytics. The student will become proficient with standard Python packages in NumPy (numerical computing) pandas (data manipulation and analysis), Matplotlib (plotting), ggplot2 (visualization), and statsmodels and other statistical packages. The student will also be introduced to machine learning (package scikit-learn), natural language processing (package NLTK), and network science (package NetworkX). Prerequisites: COMP 280, MATH351, Statistics Electives **(F;S)**

COMP 363. Object Oriented Programming   **Credits 3(3-0)**
This is a course in object-oriented program development. The main topics include encapsulation, polymorphism, inheritance, debugging and performance tuning. Prerequisites: COMP 280 **(F;S)**

COMP 365. Artificial Intelligence & Machine Learning   **Credits 3(3-0)**

This course discusses the theory and applications of artificial intelligence with a focus on machine learning. It covers the concepts related to search, knowledge representation, logical reasoning, supervised learning and unsupervised learning. Also, students will write computer programs implementing artificial intelligence and machine learning concepts. Prerequisites: COMP285 **(F;S;SS)**

COMP 368. Object-Oriented Software Development   **Credits 3(3-0)**

This course studies object-oriented software development. Object-oriented modeling, software design by pattern, software design by generic component, software reuse and object-oriented application frameworks are introduced. Problems in large software systems are discussed, and students learn how to integrate object-oriented language features into object-oriented software development. Prerequisite: COMP280 **(F;S;SS)**

COMP 375. Computer Architecture and Organization   **Credits 3(3-0)**

This course explores the design of computer systems and their architectures. Topics include central processing unit architecture, microcode, system interconnections, memory systems, input/output systems, interrupt handling, peripherals and communications networks. Prerequisites: COMP280 or ECEN327 **(F;S)**

COMP 385. Theory of Computing   **Credits 3(3-0)**

This course is the study of topics, which include theory of finite state machine and automata; regular expressions; Turing machines; grammars; parsing; language hierarchy; machine design and construction; computability; insolvability; halting problem; computational complexity; and recursive functions. The course also discusses issues in equivalence of various computational models, minimization, and characterizations. Prerequisites: COMP 360. **(F;S)**

COMP 390. Social Implications of Computing   **Credits 3(3-0)**

This course examines the increasingly complex interaction between computer systems, our social fabric and ethics. Software and microprocessors control automobiles, banks, brokerage trading, aircraft, medical equipment, and just about every other device used in industrialized nations. Impacts of computerized systems upon personal privacy and citizen involvement in governance are examined in relation to the public policy questions of the day. The role and opportunity for historically under-represented groups will be explored. Interdisciplinary readings are stressed, along with required written and oral presentations and class debates. **(F;S)**

COMP 397. Co-operative Industrial Experience I   **Credits 3(3-0)**

This is a supervised learning experience in an approved private or government facility. The student must be employed full time for at least one semester and must prefer supervised work that will enhance his/her educational background in an area related to computer science. In addition to the supervisor's evaluation in the field, the student's performance will be evaluated by a departmental faculty committee, based upon the recommendation of the Director of the Co-operative Educational Program, reports, informal portfolios and forum and/or seminar presented by the student upon his/her return to the university. Prerequisite: Permission of Advisor **(F;S)**

COMP 410. Software Engineering (Formerly COMP510)   **Credits 3(3-0)**

This course is an introduction to the principles underlying software specification, implementation, validation, and management. It addresses applications of software engineering concepts to large software systems. Team effort is emphasized throughout the course. Prerequisite: COMP285 **(F;S)**

COMP 411. Introduction to System Testing and Evaluation (Formerly COMP511) Credits 3(3-0)

This course is an introduction to methods, techniques and procedures for system testing and evaluation. The main topics include reliability measurement, testing small and large systems, black box software testing, white box software testing, testing of concurrent and real-time systems, client-server testing, test case design methods, and

auotmated testing tools. Prerequisite: COMP 410 **(F:S:SS)**

COMP 420. Applied Network Security   **Credits 3(3-0)**
This course covers network security concepts and various network security practices and solutions. Topics include cryptography, Public Key Infrastructure (PKI), taxonomy of various attack methods, firewalls, intrusion detection and prevention, Internet Protocol (IP) security, and web security.   Prerequisite: COMP280 **(F;S;SS)**

COMP 421. Security Management for Information Systems   **Credits 3(3-0)**
This course covers in-depth examination of topics in the management of information systems security including access control systems & methodology, risk management, business continuity and disaster recovery planning, legal and ethical issues in information system security, computer operations security, physical security, and information security maintenance.   Prerequisite: COMP285 **(F;S;SS)**

COMP 422. Information Privacy and Security   **Credits 3(3-0)**
This course examines the security and privacy issues associated with information systems. There are cost/risk trade-offs to be made. Discussed topics include technical, physical, and administrative methods of providing security, access control, identification, and authentication. Encryption is examined, including Data Encryption Standards (DES) and public key crypto-systems. Management considerations such as key protection and distribution, orange book requirements, and OSI data security standards are covered. Privacy issue is covered, as is current cryptographic research. The topics to be covered include; Authentication, Access Control, Encryption, Intrusion Detection, Entropy and Uncertainty, Key Management, Privacy issues, the State-of-the-Art and Research Topics on Information Privacy and Security.   Prerequisite: COMP280 **(F;S;SS)**

COMP 423 Web Security   **Credits 3(3-0)**
This course will focus on the technologies that provide security services for the World Wide Web. It will introduce a set of procedures, practices, and technologies for protecting web servers, web users, and their surrounding organizations. We will discuss, understand and use various security technologies for the World Wide Web (WWW). How these technologies secure WWW applications will also be addressed. The concept of cloud computing and cloud computing security will be introduced.   Prerequisite: COMP280 **(F;S;SS)**

COMP 440. Game Design   **Credits 3(3-0)**
This course will provide an introduction to current techniques used in game design. Topics will include game engines, game mechanics, autonomous game agents, and multi-player games. Prerequisite: COMP285 **(F;S;SS)**

COMP 452. Network Science   **Credits 3(3-0)**
This course considers empirical aspects of various kinds of networks, formal modeling and analysis of networks, and especially computational modeling and analysis. To this end, the course thoroughly covers a standard software package for network analysis and the language using the package, and it introduces packages for allied activities including machine learning. All analysis is accompanied by use of the package. Cloud resources are used for familiarity with big-data aspects, and public network libraries are used. Assignments have conceptual, formal, and especially programming components. Students should have programming experience. Prerequisite: COMP285 **(F:S:SS)**

COMP 453. Introduction to Computer Graphics (Formerly COMP553)   **Credits 3(3-0)**
This is an introductory course in fundamental principles and method in the design, use, and understanding of computer graphic systems. Topics include coordinate representations, graphics in functions, graphics algorithms and software standards. It also introduces basic two-dimensional transformations, reflection, shear; windowing

concepts, clipping algorithms, window-to-viewpoint transformations, segment concept and interactive picture-construction techniques. Prerequisite: COMP 285 **(F:S:SS)**

COMP 454. Virtual and Augmented Reality **Credits 3(3-0)**

This course covers core and state-of-art technologies and techniques of Virtual Reality, Augmented Reality, and Mixed Reality. Topics covered include: head-tracked and head-mounted displays, 3D tracking, 3D user interfaces and interactions, VR/AR applications, human perception, cognition and factors, evaluation of VR and other VR related topics. Prerequisite: COMP 280 **(F:S:SS)**

COMP 463. Introduction to Compiler Design **(Formerly COMP 563)** **Credits 3(3-0)**

This course gives an introduction to the theoretical and practical aspect of constructing compilers for computer programming languages. The course covers principles, models and techniques used in the design and implementation of compilers, interpreters, and assemblers. Each student will develop and implement a compiler. Prerequisite: COMP 285 and COMP 375 **(F:S:SS)**

COMP 468. Introduction to Data Mining **(Formerly COMP567)** **Credits 3(3-0)**

This course introduces the modern computer application of data mining. The theory of data mining is presented as well as applications of its principles in industry. This course covers the basics of techniques and applications such as cluster detection, market basket analysis, decision tree derivation, genetic algorithms, artificial neural networks, memory-based reasoning, and data warehouses. Students learn a variety of algorithms for discovering meaningful patterns and rules in large quantities of data. Prerequisite: COMP280 **(F;S;SS)**

COMP 469. Introduction to Parallel Programming **Credits 3(3-0)**

This course provides an introduction to parallel programming and problem solving. Topics include parallel programming design, parallel programming models, programming on multicore architectures, parallel computational thinking, and introduction to performance analysis of parallel algorithms. Prerequisite: COMP 350 or Consent of Instructor **(F;S;SS)**

COMP 476. Networked Computer Systems **Credits 3(3-0)**

This course presents an overview of the technology, architecture and software used by systems of network-connected computers. The course will cover data transmission, local area network architecture, network protocols, internetworking, security, and World Wide Web technology. Students will write programs that run concurrently on multiple computers. Prerequisite: COMP 280 or ECEN327 **(F;S)**

COMP 485. Special Topics in Computer Science **(Formerly COMP590)** **Credits 3(3-0)**

This course permits the exploration of advanced topics pertinent to student's program of study in a seminar setting. **(F;S)**

COMP 494. Independent Study **(Formerly COMP500)** **Credits 3(3-0)**

This course can be used for study of advanced topics in computer science pertinent to the student's interest under supervision of a faculty member. Prerequisite: Permission of Instructor **(F:S:SS)**

COMP 495. Senior Project I **(Formerly COMP595)** **Credits 3(3-0)**

This course is the first course in a two-semester sequence, which allows students the opportunity to design and start implementation and testing of this two-semester project. Each project will be developed with the consultation of a faculty advisor and will be a team effort. Each team will be made up of two or three students. Projects started in this course will be completed in COMP496, giving each team the opportunity to work on a project of significant size. Prerequisite: COMP285; Corequisite: COMP410 **(F;S;SS)**

COMP496. Senior Project II   **Credits 3(3-0)**
This course is a continuation of the COMP495 Senior Project I course. It allows students to design and implement a year-long software project that was started in COMP495 and complete the project in this course. This course gives students the opportunity to work on a software project of significant size. Prerequisite: COMP410 and COMP495 (**F;S;SS)**