Armstrong

UNIVERSITY CURRICULUM COMMITTEE
University Hall 282
Minutes, November 6, 2013
(With amendment to Economics items at Faculty Senate, November 18, 2013)

PRESENT: Suzanne Carpenter, Becky da Cruz, Mirari Elcoro, Catherine Gilbert, Sara Gremillion, Robert Harris, Jackie Kim, David Lake, Kam Fui Lau, Denene Lofland. Lauren Mason, Rick McGrath (Chair), Anthony Parish, Phyllis Fulton (Catalog Editor)

GUESTS: Bill Baird, James Brawner, Cameron Coates, Bob Gregerson, John Kraft, Teresa Winterhalter

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CALL TO ORDER. The meeting was called to order at 3:07 p.m. by Dr. Rick McGrath.

APPROVAL OF MINUTES. The minutes of October 2, 2013 were approved as presented.

ITEMS

I. College of Education (no items)

II. College of Health Professions (no items)

III. College of Liberal Arts

A. Art, Music, and Theatre (no items)
B. Criminal Justice, Social, and Political Science (no items)

C. Economics

Items 1-11 from the Department of Economics were discussed and approved by the committee. They are being submitted to the Faculty Senate for approval.

1. **Create the following course:**
   MGMT 3111 SKILLS IN ENTREPRENEURSHIP 3-0-3
   Prerequisite: Must have completed a minimum of 60 credit hours.
   A project-based class for students in all majors. Focuses on basic knowledge and skills needed to start a commercial business or begin a career. Topics include basic marketing, financial, and management concepts that promote individual

talents, create career opportunities, and create financial gain from skills and talents developed in any discipline.

Rationale: Course content and instruction is appropriate as a management course.

Effective Term: Fall 2014

CURCAT:
Major Department: Economics
Can Course be repeated for additional credit? NO
Maximum Number of Credit Hours: 3
Grading Mode: Normal
Instruction Type: Lecture
Course Equivalent: ECON 3111

2. **Create the following course:**
MGMT 3220 MANAGEMENT **3-0-3**
Prerequisite: ECON 2106
Management of organizations with an emphasis on the fundamentals of organizational behavior. Topics include organizational structure, leadership, communication, motivation, group dynamics, decision -making, planning and controlling. Business ethics and the roles and functions of managers are integrated throughout all these topics.

Rationale: Course content and instruction is appropriate as a management course.

Effective Term: Fall 2014

CURCAT:
Major Department: Economics
Can Course be repeated for additional credit? NO
Maximum Number of Credit Hours: 3
Grading Mode: Normal
Instruction Type: Lecture
Course Equivalent: ECON 3220

3. **Create the following course**
MGMT 4111 ENTREPRENEURSHIP **3-0-3**
Prerequisites: MKTG 3210 and ECON 3230 or permission of instructor
A project based class focusing on the application of economic principles to real-world business formation and management. This course provides instruction in both the legal and logistical requirements of starting a business and serves as a forum for development of business ideas and practices.

Rationale: Course content and instruction is appropriate as a management course.

Effective Term: Fall 2014

CURCAT:
Major Department: Economics
Can Course be repeated for additional credit? NO
Maximum Number of Credit Hours: 3
Grading Mode: Normal
Instruction Type: Lecture
Course Equivalent: ECON 4111

4. **Create the following course**
MKTG 3210 MARKETING **3-0-3**
Prerequisite: ACCT 2101 and ECON 2106
Marketing functions, the activities of producers, wholesalers, retailers and other intermediaries, the channels of distribution, integration of the marketing functions, price policies and government regulation.

Rationale: Course content and instruction is appropriate as a marketing course.

Effective Term: Fall 2014

CURCAT:
Major Department: Economics
Can Course be repeated for additional credit? NO
Maximum Number of Credit Hours: 3
Grading Mode: Normal
Instruction Type: Lecture
Course Equivalent: ECON 3210

5. **Create the following course:**
MKTG 3800 QUANTITATIVE MARKETING RESEARCH **3-0-3**
Prerequisite: ECON 2106 and MATH 2200
Research design, data sources and collection, project and client management, data analysis, and reporting/presentation of empirical results pertaining to quantitative studies of consumer behavior. Requires use of computers for statistical analysis and presentations.

Rationale: Course content and instruction is appropriate as a marketing course.

Effective Term: Fall 2014

CURCAT:
Major Department: Economics
Can Course be repeated for additional credit? NO
Maximum Number of Credit Hours: 3
Grading Mode: Normal

Instruction Type: Lecture
Course Equivalent: ECON 3800

6. **Delete the following courses**
   ECON 3111 – SKILLS IN ENTREPRENEURSHIP
   ECON 3220 – MANAGEMENT
   ECON 4111 – ENTREPRENEURSHIP
   ECON 3210 – MARKETING
   ECON 3800 – QUANTITATIVE CONSUMER RESEARCH

   Rationale: The creation of new courses in management and marketing has made these courses redundant.

   Effective Term: Fall 2014

7. **Request for blanket catalog change replacement by catalog editor**
   ~~ECON 3111~~ to MGMT 3111
   ~~ECON 3220~~ to MGMT 3220
   ~~ECON 4111~~ to MGMT 4111
   ~~ECON 3210~~ to MKTG 3210
   ~~ECON 3800~~ to MKTG 3800

   Rationale: There is no change in level, prerequisite or content to mandate line-by-line approval of each change in the catalog.

   Effective Term: Fall 2014

8. **Modify the noted sections of the following program of study:**

PROGRAM FOR THE DEGREE OF BACHELOR OF ARTS IN ECONOMICS

Track I: General Economics

C. Related Field Courses .....9 hours
ITEC 1050 – Introduction to Computer Concepts and Applications ~~or CSCI 1060 – Computer Concepts~~
Six credit hours of upper division courses from the following fields: anthropology, communication, economics, English (3720, 5710, 5740, 5750 only), geography, information technology, management, marketing, mathematics, philosophy, political science, psychology, or sociology.

Comment [PF1]: Catalog error caught and changed by Faculty Senate. Friendly amendment to remove CSCI 1060 because it is no longer taught.

Track II: International Economics

B. Major Field Courses .....33 hours
ECON 3050 – Intermediate Macroeconomics
ECON 3060 – Intermediate Microeconomics

ECON 3200 – International Trade
ECON 3700 – Econometrics
ECON 4310 – International Finance
ECON 4900 – Economic Methods and Senior Thesis
Fifteen credit hours drawn from among the following courses:
ECON 3100 – Multinational Economics Enterprises
ECON 3210 – Marketing
ECON 3220 – Management
ECON 3230 – Finance
ECON 3300 – Money and Banking
ECON 3450 – Environmental Economics
ECON 3460 – Economics of Immigration
ECON 3470 – Economics of Health
ECON 3500 – Managerial Economics
ECON 3960 – Research in International Economics
ECON 4100 – Financial Economics: Portfolio Analysis
ECON 4150 – Money and Capital Markets
ECON 4400 – Seminar in Third World Economic Development
ECON 4450 – Comparative Economics
ECON 4500 – Public Finance
MGMT 3111 – Skills in Entrepreneurship

Track III: Business Economics

B. Major Field Courses ..... 33 hours
ECON 3050 – Intermediate Macroeconomics or ECON 3060 Intermediate Microeconomics
ECON 3210 – Marketing
ECON 3220 – Management
ECON 3230 – Finance
ECON 3300 – Money and Banking
ECON 3500 – Managerial Economics
ECON 4111 – Entrepreneurship
Twelve credit hours drawn from among the following courses:
ECON 3050 – Intermediate Macroeconomics
ECON 3060 – Intermediate Microeconomics
ECON 3100 – Multinational Economic Enterprises
ECON 3200 – International Trade
ECON 3400 – Economics of Labor
ECON 3450 – Environmental Economics
ECON 3460 – Economics of Immigration
ECON 3470 – Economics of Health
ECON 3700 – Econometrics
ECON 3800 – Quantitative Consumer Research
ECON 4100 – Financial Economics: Portfolio Analysis
ECON 4150 – Money and Capital Markets
ECON 4310 – International Finance

ECON 4410 – Regional Economics
ECON 4450 – Comparative Economics
ECON 4451 – Industrial Organization
ECON 4500 – Public Finance
ECON 4520 – Internship (with permission of department head)(maximum of three credits may count toward Major Field Courses)
MGMT 3111 – Skills in Entrepreneurship

Rationale: Keeps the course choices for the general track unchanged; replaced ECON ~~4112~~4111, which was previously removed, with MGMT 3111 in ~~Tracks II and III.~~Track II.

Effective Term: Fall 2014

9. **Create the following course:**
BUSA 2106 – ENVIRONMENT OF BUSINESS **3-0-3**
Pre-requisite: ENGL 1101
An introduction to the legal, regulatory, political, social, ethical, cultural environmental and technological issues which form the context for business; to include an overview of the impact and demographic diversity on organizations.

Rationale: This is a standard Area F course for business degrees in the University System of Georgia.

Effective Term: Fall 2014 (Conditional on approval of the BS in Business Economics by the USG Board of Regents)

CURCAT:
Major Department: Economics
Can Course be repeated for additional credit? NO
Maximum Number of Credit Hours: 3
Grading Mode: Normal
Instruction Type: Lecture
Course Equivalent: None

10. **Create the following degree program**

PROGRAM FOR THE DEGREE OF BACHELOR OF SCIENCE IN BUSINESS ECONOMICS

A. General Requirements
Core Areas A, B, C, D.II.a, and E.....42 hours
(MATH 2200 Elementary Statistics required in area D.3.)
Area F.....18 hours
ACCT 2101 – Principles of Financial Accounting
ACCT 2102 – Principles of Managerial Accounting

Comment [PF2]: Remove this. Changed in Faculty Senate. Since nothing in Track III has changed, entire track can be removed from minutes to avoid confusion.

Comment [PF3]: Rationale amended by Faculty Senate.

BUSA 2106 – Environment of Business
ECON 2105 – Principles of Macroeconomics
ECON 2106 – Principles of Microeconomics
ITEC 1050 – Computer Concepts and Applications
Physical Education.....3 hours
First Year Seminar ..... 1 hour

B. Major Field Courses .....30 hours

ECON 3230 – Finance
ECON 3700 – Econometrics or ECON 3800 – Quantitative Marketing Research
MGMT 3220 – Management
MGMT 4111 – Entrepreneurship or ECON 4900 – Economic Methods and Senior Thesis
MKTG 3210 – Marketing
Six credits selected from:
- ECON 3050 – Intermediate Macroeconomics and ECON 3060 – Intermediate Microeconomics
- ECON 3050 – Intermediate Macroeconomics and ECON 3500 – Managerial Economics
- ECON 3060 – Intermediate Microeconomics and ECON 3300 – Money and Banking

Nine hours selected from:
- ECON 3200 – International Trade
- ECON 3300 – Money and Banking
- ECON 3400 – Economics of Labor
- ECON 3450 – Environmental Economics
- ECON 3460 – Economics of Immigration
- ECON 3470 – Economics of Health
- ECON 3500 – Managerial Economics
- ECON 3800 – Marketing Research
- ECON 4100 – Financial Economics: Portfolio Analysis
- ECON 4150 – Money and Capital Markets
- ECON 4310 – International Finance
- ECON 4410 – Regional Economics
- ECON 4450 – Comparative Economics
- ECON 4451 – Industrial Organization
- ECON 4500 – Public Finance
- ECON 4520 – Internship
- MGMT 3111 – Skills in Entrepreneurship

C. Related Field Courses.....15 hours

COMM 2280 – Speech Communication
ENGL 3720 – Business and Technical Communication
MATH 1161 – Calculus I or Math 1950 – Applied Math for Non-Science Majors (if not taken in the core)
PHIL 2030 Introduction to Ethics and Moral Issues
Three credits from:
- COMM 3060 – Public Relations
- COMM 5050U – Interpersonal Communication in the Workplace
- COMM 5500U – Communication Between the Genders
- ENGL 5710U – Writing for the Non-Profit Sector
- ENGL 5740U – Technical Editing

ENGL 5750U – Publication Design

D. Electives .....15 hours

Students must complete a set of courses that would qualify for an academic minor outside the economics department. The student may choose to forgo formal awarding of the minor if courses are used in the core curriculum.

Rationale: The Bachelor of Science in Business Economics establishes a new business degree at Armstrong. The key characteristics that make the program unique are the emphasis on soft skills (ethics and communication) that are in high demand in the business community, and the requirement that students complete the courses to qualify for an academic minor to provide the graduate with a field of expertise in which to apply those business skills. Further components of the rationale including growth in the business economics track of the BA in Economics and the occupational importance of the degree are in the attached prospectus under review by the BOR. **See Attachment 1**

Effective Term: Fall 2014 (Conditional on approval of the BS in Business Economics by the USG Board of Regents)

11. Amend Economics catalog text entry

The Department of Economics at Armstrong Atlantic State University blends the liberal arts with practical skills to provide students with a rich educational experience and a background for intelligent decision making. Students have the choice of a Bachelor of Science in Business Economics, or a Bachelor of Arts in Economics with three major tracks in the Bachelor of Arts: **general economics, international economics, and business economics**. The department also offers minors in business and in economics, and a certificate in financial economics.

Effective Term: Fall 2014 (Conditional on approval of the BS in Business Economics by the USG Board of Regents)

D. Gender and Women's Studies (no items)

E. History

Items 1-5 from the Department of History were postponed until the next meeting. They have been removed from the minutes.

F. Languages, Literature, & Philosophy (no items)
G. Liberal Studies (no items)
H. Honors Program (no items)

IV. College of Science and Technology

A. Biology (no items)

B. Chemistry and Physics

Item 1 from the Department of Chemistry and Physics was postponed until the next meeting. It has been removed from the minutes.

Items 2-3 from the Department of Chemistry and Physics were discussed and approved by the committee. They are being submitted to the Faculty Senate for approval.

2. Modify the following program of study

PROGRAM FOR THE DEGREE OF BACHELOR OF SCIENCE IN APPLIED PHYSICS

B. Major Field Courses ..... 30 hours

Choose one of the following courses:

PHYS 3100 – Electrical Circuit Analysis or ENGR 3100 – Circuit Analysis

PHYS 3120 – Digital Electronics

PHYS 3300 – Thermodynamics or PHYS 3400 – Chemical Thermodynamics
PHYS 3801K – Modern Physics
PHYS 3802 – Introduction to Quantum Mechanics
PHYS 4120 – Scientific Measurement with Digital Interfacing
PHYS 4170 – Advanced Mechanics

~~Nine~~ Choose twelve semester hours from:

PHYS 2900 – Introduction to Research in Physics
PHYS 3100 – Electrical Circuit Analysis or ENGR 3100 – Circuit Analysis (if not previously counted above)
PHYS 3120 – Digital Electronics (if not previously counted above)
PHYS 3142 – Computational Physics
PHYS 3200 – Mathematical Methods for Physicists
PHYS 3220 – Mechanics of Deformable Bodies
PHYS 3230 – Fluid Mechanics
PHYS 3312 – Electromagnetism
PHYS 3500 – Diffraction and Crystallography
PHYS 3700K – Optics
PHYS 4800 – Pedagogy and Supplemental Instruction in Physics (maximum of 3 hours can be used in this section)
PHYS 4900 – Independent Study in Physics
PHYS 4950 – Special Topics in Physics
PHYS 4960 – Physics Internship
PHYS 4991 – Advanced Research in Physics

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Rationale: These will insure that a physics major gets exposure to circuits by taking either Digital Electronics or Circuits or both by choice. Designating the list to be twelve instead of nine is necessary to get the correct number of hours for the Major Field Courses.

Effective Term: Fall 2014

3. Modify the following course:
PHYS 4120 SCIENTIFIC MEASUREMENT WITH DIGITAL INTERFACING 1-5-3
Prerequisite: ~~PHYS 3120 (minimum grade of C) and~~ CSCI 1301 (minimum grade of C) and either PHYS 3120 (minimum grade of C) or PHYS 3100 (minimum grade of C) or ENGR 3100 (minimum grade of C)

Rationale: The prerequisite options are required to accommodate the program options proposed.

Effective Term: Fall 2014

C. Computer Science and Information Technology (no items)

D. Engineering Studies

Items 1-10 from the Engineering Studies Program were discussed and approved by the committee. They are being submitted to the Faculty Senate for approval.

1. **Create the following course:**
ENGR 2035 Programming for Hardware/Software Systems 3-3-4
Prerequisite: ENGR 2030
Description: Programming techniques for hardware and software systems including creation of complex execution and storage mechanisms based on instruction set architecture and software design including programming languages and operating systems. Students will apply and develop these concepts through programming design projects.

Rationale: The creation of this course reflects new content required of Electrical and Computer Engineering majors who transfer to Georgia Tech or Georgia Southern via the RETP program. This course is equivalent to the Georgia Tech ECE 2035 course. Electrical Engineering majors at Georgia Tech must now take ECE 1371 and either ECE 2035 or ECE 2036. Computer Engineering majors at Georgia Tech must now take ECE 1371 and both ECE 2035 and ECE 2036.

Effective Term: Fall 2014

CURCAT:
Major Department: Engineering Studies
Can Course be repeated for additional credit? No
Maximum Number of Credit Hours: 4
Grading Mode: Normal
Instruction Type: Lecture and Laboratory
Course Equivalent: None

2. **Create the following course:**
   ENGR 2036 Engineering Software Design **3-3-4**
   Prerequisite: ENGR 2030; Prerequisite or Co-requisite: ENGR 2025
   Description: Object-oriented software methods for engineering applications including numerical analysis methods; simulations and graphical presentation of simulation results; and analysis of numerical precision. Students will apply and develop these concepts through programming projects.

   Rationale: The creation of this course reflects new content required of Electrical and Computer Engineering majors who transfer to Georgia Tech or Georgia Southern via the RETP program. This course is equivalent to the Georgia Tech ECE 2036 course. Electrical Engineering majors at Georgia Tech must now take ECE 1371 and either ECE 2035 or ECE 2036. Computer Engineering majors at Georgia Tech must now take ECE 1371 and both ECE 2035 and ECE 2036.

   Effective Term: Fall 2014

   CURCAT:
   Major Department: Engineering Studies
   Can Course be repeated for additional credit? No
   Maximum Number of Credit Hours: 4
   Grading Mode: Normal
   Instruction Type: Lecture and Laboratory
   Course Equivalent: None

3. **Modify the following course:**
   ENGR 3220 Mechanics of Materials 3-0-3
   Prerequisite: ~~ENGR 2020 or ENGR 2201~~ ENGR 2001

   Rationale: ENGR 2020 and ENGR 2201 were removed from the curriculum several years ago to remain consistent with Georgia Tech modifications. ENGR 3220 is equivalent to Georgia Tech's COE3001. It is mandatory for mechanical, civil, and aerospace engineering majors and an elective for other engineering majors.

   Effective Term: Fall 2014

4. **Create the following course to support the BSES degree**
   ENGR 3145 Structures Lab **1-2-2**
   Prerequisite: ENGR 3220
   Description: Introduction to mechanical measurements, instrumentation principles and practice, measurement of stress and strain, shear center, column stability, properties of composite structural materials, fracture toughness test.

   Rationale: Some version of this course is offered in ABET accredited institutions for aerospace, mechanical and civil engineering students. This course is

multidisciplinary and includes content consistent with the objectives of the BSES program.

Effective Term: Fall 2014, Pending BOR approval of degree

CURCAT:
Major Department: Engineering Studies
Can Course be repeated for additional credit? No
Maximum Number of Credit Hours: 2
Grading Mode: Normal
Instruction Type: Lecture and Laboratory

5. **Create the following course to support the BSES degree:**
ENGR 3741 Instrumentation and Electronics Lab 1-2-2
Prerequisite: ENGR 3100
Description: Basic analog and digital electronic circuits and principles. Techniques of electrical and electronic measurements with laboratory instruments.

Rationale: Some version of this course is offered in ABET accredited institutions for aerospace, mechanical, electrical and mechatronic engineering students. This course is multidisciplinary and includes content consistent with the objectives of the BSES program.

Effective Term: Fall 2014, Pending BOR approval of degree

CURCAT:
Major Department: Engineering Studies
Can Course be repeated for additional credit? No
Maximum Number of Credit Hours: 2
Grading Mode: Normal
Instruction Type: Lecture and Laboratory

6. **Create the following course to support the BSES degree:**
ENGR 3515 System Dynamics and Controls 3-0-3
Prerequisite: ENGR 1371, ENGR 2202, MATH3411
Description: Dynamic modeling and simulation of systems with mechanical, hydraulic, thermal and/or electrical elements. Frequency response analysis, stability, and feedback control design of dynamic systems.

Rationale: Some version of this course is offered in ABET accredited institutions for aerospace, mechanical, electrical, mechatronic and industrial engineering students. This course is multidisciplinary and includes content consistent with the objectives of the BSES program.

Effective Term: Fall 2014, Pending BOR approval of degree

CURCAT:
Major Department: Engineering Studies
Can Course be repeated for additional credit? No
Maximum Number of Credit Hours: 3
Grading Mode: Normal
Instruction Type: Lecture

7. **Create the following course to support the BSES degree:**
ENGR 4125 Structural Mechanics **3-0-3**
Prerequisite: ENGR 1371, ENGR 3220
Description: Analysis of beams, columns, tensioned beams, trusses, frames, cables, and shafts of general shape and material. Bending, shearing and torsion of thin walled structures. Exact and approximate methods. Examples from civil, mechanical, offshore, aerospace and ship structures.

Rationale: Some version of this course is offered in ABET accredited institutions for aerospace, mechanical, mechatronic and civil engineering students. This course is multidisciplinary and includes content consistent with the objectives of the BSES program.

Effective Term: Fall 2014, Pending BOR approval of degree

CURCAT:
Major Department: Engineering Studies
Can Course be repeated for additional credit? No
Maximum Number of Credit Hours: 3
Grading Mode: Normal
Instruction Type: Lecture and Laboratory

8. **Modify the following course:**
ENGR 1100 Introduction to Engineering 1-2-2~~3 0 3~~

Rationale: Engineering education research suggests that introductory engineering courses will be more successful if primarily project based. The First Year Seminar addresses some of the ENGR 1100 objectives (student's ability to find and use information effectively). Therefore three lecture hours are no longer needed.

Effective Term: Fall 2014

CURCAT:
Major Department: Engineering Studies
Can Course be repeated for additional credit? No
Maximum Number of Credit Hours: ~~3~~2
Grading Mode: Normal
Instruction Type: Lecture and Laboratory

9 Create the following course to support the BSES degree:
ENGR 4110 Engineering Capstone Design 3-3-4
Prerequisite: ENGR 2110, ENGR 3145 or ENGR 3741
Description: A major engineering design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints. The capstone design course serves as a final preparation for students entering into industry. The design projects are selected from problems submitted by the students, faculty and local industry. Industry projects are given preference since these projects are best suited for meeting the course objectives.

Rationale: A final design course that provides an engineering student the opportunity to apply theoretical constructs within the limitations of the varied assumptions and real world constraints is recommended at the end of all traditional engineering curricula. It is a necessary component if an engineering program wishes to seek for accreditation by the Accreditation Board of Engineering and Technology (ABET).

All four year undergraduate engineering students take senior design course that requires the application of the knowledge gained in earlier courses to the design process. The objectives are to:

a. Familiarize the student with the engineering design process: Definition, Synthesis, Analysis and Implementation.
b. Improve communication skills.
c. Promote organizational skills.
d. Stress importance of other influences on design such as economics, reliability, performance, safety, ethics and social impacts.
e. Simulate the post graduate job environment

Effective Term: Fall 2014, Pending BOR approval of degree

CURCAT:
Major Department: Engineering Studies
Can Course be repeated for additional credit? No
Maximum Number of Credit Hours: 4
Grading Mode: Normal
Instruction Type: Lecture and Laboratory
Course Equivalent: None

10. Create the Bachelor of Science in Engineering Science jointly with Savannah State University

PROGRAM FOR THE DEGREE OF BACHELOR OF SCIENCE IN ENGINEERING SCIENCE

A. General Requirements

Core Areas A, B, C, D, and E .....42 hours

Engineering Science majors are required to take MATH 1161 in core area A, MATH 2072 in core area D, PHYS 2211K and PHYS 2212K in core area D

Area F.....18 hours

One hour excess for MATH 1161 from area A

One hour excess for MATH 2072 from Area D

CHEM 1211 (and lab) - Principles of Chemistry I

ENGR 1100 - Introduction to Engineering

ENGR 1170 (and lab) - Engineering Graphics

ENGR 1371 - Computing for Engineers

MATH 2083 - Calculus III

Physical Education.....3 hours

First Year Seminar ..... 1 hour

B. Major Field Courses .....30 hours

ENGR 2001 - Statics

ENGR 2110 - Creative Decisions and Design

ENGR 3100 - Electrical Circuits

ENGR 3322 - Fundamentals of Thermodynamics

ENGR 3741 - Instrumentation and Electronic Measurement or ENGR 3145 Structures Lab

ENGR 4110 - Senior Capstone Design

Twelve hours of upper level engineering courses selected from the following:

ENGR 3211- Electronics

ENGR 3220 - Mechanics of Materials

ENGR 3230 - Fluid Mechanics

ENGR 3312– Electromagnetism

ENGR 3320 - Heat Transfer

ENGR 3515 - Systems and Controls

ENGR 4120 - Scientific Measurement

ENGR 4125 - Structural Mechanics

C. Related Field Courses.....30 hours

MATH 2160 - Linear Algebra

MATH 3411 - Differential Equations

STAT 3211 - Probability and Statistics Applications I

21 hours selected from the following, with at least 9 hours at the 3000 level or higher:

<u>1000-2000 level</u>

BIOL 1107 (and lab) - Principles of Biology I

BIOL 1108 (and lab) - Principles of Biology II

BIOL 2081 (and lab) - Human Anatomy and Physiology

CHEM 1212 (and lab) - Principles of Chemistry II

CHEM 2101/2101L - Organic Chemistry I/Organic Chemistry I Lab

CHEM 2300 (and lab) - Principles of Chemical Analysis

CSCI 1302 - Programming Principles II

CSCI 2410 - Data Structures

CSCI 2490 - C++ programming

CSCI 2625 - Discrete Structures for Computer Science

ENGR 2000 - Material Science and Engineering

ENGR 2010 - Computational Modeling

ENGR 2025 - Introduction to Signal Processing
ENGR 2030 - Introduction to Computer Engineering
ENGR 2031 - Digital Design Laboratory
ENGR 2035 - Programming for Hardware/Software Systems
ENGR 2036 - Engineering Software Design
ENGR 2202 - Dynamics
MATH 2160 - Linear Algebra

3000-4000 level (at least 9 hours must be from this list)

CHEM 3100 - Forensic Chemistry
CSCI 3202 - Computer Organization and Architecture
CSCI 3301 - Unix and Secure Web Development
CSCI 3330 - Comparative Languages
CSCI 3341 - Introduction to Operating Systems
CSCI 3370 - Human Computer Interaction
CSCI 3720 - Database Systems
CSCI 5210U - High Performance Computing
CSCI 5220U - Networks
CSCI5360U - Embedded Systems Programming
CSCI 5700U - Computer Security
CSCI 5820U - Machine Learning
CSCI 5825U - Artificial Intelligence
CSCI 5830U - Computer Graphics
MATH 3000 - Introduction to Mathematical Proof
MATH 3480 - Optimization
MATH 4060 - Functions of a Complex Variable
MATH 4610 - Numerical Analysis
PHYS 3210 - Intermediate Mechanics
PHYS 3300 - Thermodynamics
PHYS 3400 - Chemical Thermodynamics
PHYS 3700K - Optics
PHYS 3801K - Modern Physics
PHYS 4170 - Advanced Mechanics
STAT 3222 - Probability and Statistics Applications II
STAT 3231 - Mathematical Statistics I
STAT 3240 - Experimental Design

Total Semester Hours .....124 hours

D. Exit Exam

Rationale: See Attachment 2

Effective Term: Fall 2014, Pending BOR approval

E. Mathematics

Item 1 from the Department of Mathematics was discussed and approved by the committee. It is being submitted to the Faculty Senate for approval.

1. **Modify the following program of study to change the requirements for the applied mathematics concentration in actuarial science.**

PROGRAM FOR THE DEGREE OF BACHELOR OF SCIENCE IN MATHEMATICAL SCIENCES

Option 2: Applied Mathematics

C. Related Field Courses ..... ~~21~~18-27 hours

CSCI 1302 – Advanced Programming Principles

Complete the prescribed courses in one of the following concentration areas and, if needed, additional courses to complete the requirement of at least 39 semester hours of upper-division courses. These additional courses may be chosen from mathematics, the concentration area, ENGL 3720, or HIST 5640U.

Actuarial science:

ECON 2105 or ECON 2106
STAT 3211 (if not taken as a major field course)
STAT 3222
~~MATH 3251 or 3460~~
MATH 4200
Two courses selected from:
ECON 3050, 3060,3230, ~~3500, 3600,~~ or 3700~~, or 5300U~~

Operations research:

Complete 6 of the 7 courses:
STAT 3222 – Probability and Statistics Applications II
MATH 3251 – Combinatorics
MATH 3460 – Introduction to Operations Research
MATH 3480 – Optimization
MATH 4340 – Graph Theory
MATH 4400 – Operations Research Seminar
MATH 4610 – Numerical Analysis

Statistics:

STAT 3222 – Probability and Statistics Applications II
STAT 3231 – Mathematical Statistics I
STAT 3232 – Mathematical Statistics II
STAT 3240 – Experimental Design
MATH 3251 – Combinatorics
MATH 4610 – Numerical Analysis

Minor in:

biology, chemistry, computer science, cyber security, information technology, economics, engineering studies, applied physics, physical sciences, psychology, mental health, or organizational psychology

D. Electives ..... 12-~~18~~ 21 hours

Rationale: In order to provide our majors with a better opportunity to pursue a certificate in actuarial sciences upon completion of their actuarial science concentration in Applied Mathematics, the courses STAT 3211 and ECON 3230 were added. The courses MATH 3251, MATH 3460, ECON 3500, ECON 3600, and ECON 5300U were deleted from the concentration in Applied Mathematics due to the aforementioned replacements providing students better preparation towards the Probability (Exam 1 or Exam P) and Financial Mathematics (Exam 2 or Exam FM) actuarial exams and completion of the required educational experiences as set forth by the Society of Actuaries and Casualty Actuarial Society.

F. Psychology (no items)

ADJOURNMENT. The meeting was adjourned at 4:29 p.m.

Respectfully submitted,

Phyllis L. Fulton
Catalog Editor and Secretary to the Committee

PROSPECTUS

Institution: Armstrong Atlantic State University Date: Fall 2013
School/ division: College of Liberal Arts Department of Economics
Name of Proposed Degree: Bachelor of Science in Business Economics
Degree: BS Major: Business Economics CIP Code: 52.060105
Starting Term: Fall 2014

BS in Business Economics

PROGRAM DESCRIPTION

The Department of Economics in the College of Liberal Arts at Armstrong Atlantic State University proposes the development of a Bachelor of Science in Business Economics (BE). Business Economics is a specialized area of economics that uses economic analysis to make strategic business and management decisions. Armstrong's Business Economics degree, emphasizing workforce development and firmly informed by a liberal arts education, provides an opportunity for students to gain practical business skills and to develop complex practical reasoning. All skills are useful in addressing the complexity and ambiguity of human and resource management common in the workplace. The proposed degree will integrate business and liberal arts, foster integrative thinking skills, allowing leaders to look at the many, often opposing, data and phenomena that bear upon a problem or situation, find connections, determine patterns, and resolve conflicts. This degree will prepare its graduates for a knowledge-based economy that relies on creativity and critical thinking while providing the quantitative skills essential for the analysis of business problems. The degree emphasizes the need for strong communication skills and ethical business practices and behavior; the lack thereof contributed to a global financial crisis and recession from which the world still has not yet recovered.

Armstrong's Business Economics degree will enable individuals to use a number of methods to better understand and analyze current conditions, to reflect on past business decisions, and to evaluate future risks and opportunities. This degree can be differentiated from a traditional business degree by a focus on a deep understanding of the economic environment within which businesses operate. Also, the degree will pay particular attention to the development of students' "soft skills," including effective communication, teamwork, and ethical perspectives. It also emphasizes disciplinary-based contextual knowledge. Additional coursework in a required minor will provide the background necessary to be successful in specific workplace environments, such as health services and non-profit management. Emerging themes in contemporary workforce development emphasize the increasing importance of communication skills and workplace ethics, thus mandating the consideration of these important skills in the proposed major. Armstrong's Business Economics degree will require three courses in communications and two courses in ethics.

Requiring students to pursue a minor allows them to apply their business skills to a specific field of interest. For instance, a student with a major in Business Economics and minor in Theater will be better prepared to oversee theater operations as compared to a student of business without a minor. Other minors, such as in Health Science prepares students for management positions in a wide variety of non-profit or other organizations by providing meaningful contextual background and disciplinary knowledge.

The major requires a capstone course experience that enables students to interweave contextual knowledge, analytical skills, communication skills, and other skills developed in the program of study. In the capstone course, students will complete a research project grounded in the minor area of interest, and informed by, and cognizant of, ethical issues pertinent to the chosen minor. Oral and written communication skills are to be emphasized in the preparation and presentation of project output before peers. Therefore, this final project will further help groom students for complexities and challenges common in the workplace.

JUSTIFICATION OF NEED FOR THE PROGRAM

Clear ties to economic development in the state

Given the analytical nature and diversity of the discipline, Business Economics will provide a solid background for many jobs and professions. In fact, the National Association of Business Economists offers its members the opportunity to join twelve different associations (roundtables) directly related to their job functions, making clear the versatility of its members. These roundtables include: corporate planning, energy, health, financial, international, manufacturing, real estate, utility, entrepreneur, technology, transfer pricing and transportation. Many, if not most, of these roundtables are organized around what Georgia's Department of Economic Development considers to be key industrial sectors in the state. Therefore, Armstrong's Business Economics degree will prepare its majors for employment in many different and key sectors of Georgia's economy and will contribute to the state's economic development.

The Georgia Department of Economic Development (GDED) notes the importance of Fortune 500 companies in the overall economic development strategy of the state, declaring in its global marketing materials that "Fortune Favors the Peach." A survey of employment opportunities offered by the sixteen Fortune 500 companies headquartered in Georgia from May 13 to July 13, 2013 revealed that 324 positions were posted for which Business Economics graduates would be well qualified. These positions include business analysts, financial analysts, and data analysts. The same search indicated that Aflac, UPS, the Coca-Cola Company, and SunTrust posted the largest number of job opportunities (185) for various categories of analysts to be filled by individuals with the education and experience that a Business Economics degree would offer.

State and regional occupational projections

The proposed degree will offer its graduates the opportunity to pursue various occupations depending on their course of studies. The students who elect to focus on applied minors with fewer empirical components will be prepared to work in occupations emphasizing the conceptual framework of the business landscape. On the other hand, students who pursue quantitative-based minors will be positioning themselves for analytical and data intensive opportunities. This versatility within the major allows Armstrong to place graduates into a wider range of potential careers.

The Georgia Department of Labor Long Run Occupational Projections for 2010-2020 for selected job categories pertinent to Armstrong Business Economics degree is provided in Table (1). The prospects for the graduates focusing on applied minors, such as Health Science, International Studies, and Organizational Psychology are bright. In total, there is projected

growth of at least 38,840 jobs suited for graduates with this degree. Among these, there is projected growth of 23,200 jobs in management occupations. The largest growth will be in management of companies (increasing by 6,390 jobs), followed by medical and health services managers (2,640), administrative service managers (1,800) and construction managers (1,650). Further, note that for those students interested in the management of non-profit institutions, there is a projected growth of 1,470 jobs. These leadership positions are among the higher-paying jobs in the state, with the medical and health services managers earning a mean annual salary of $84,270, and administrative service managers earning a mean of annual salary of $77,890 in 2012.

The same table indicates that there is an increasing demand for employees with stronger analytical skills and problem-solving capabilities. Students with minors in Mathematical Sciences, Statistics, and Information Technology, for example, would be well-equipped for analytical positions. A projection for job growth of 15,640 among professionals such as management analysts, financial analysts, and market research analysts is an indication of such a strong demand. The largest growth is the need for management analysts (increasing by 7,530 jobs), followed by market research analysts (2,940), cost estimators (1,190) and financial analysts (1,070). These positions also tend to be among the higher-paying jobs in the state, for instance, management analysts earned a mean annual wage of $90,210 and market research analysts earned a mean annual wage of $64,140 in 2012.[1]

At the regional level, based on the Workforce Occupations and Skills Projections report by Clemson Institute for Economic and Community Development, the Upper Savannah Area Employment Projection for 2008-2016 is for 27% growth in various positions suitable for graduates with a degree in Business Economics.[2] The most rapid growth will be in the area for personal financial advisors, with projected growth of 47%.

Finally, during 2012, the Department of Economics Business Advisory Board has recommended the development of this major as its members believe there is solid and growing demand for graduates with a Business Economics degree in the Savannah metropolitan area. The advisory board is composed of a broad cross-section of representatives from the Savannah area business community including economic development, banking and finance, aerospace manufacturing, and small business.

Potential job placement opportunities

Research was conducted utilizing four different sources of job information pertaining to positions suited for Business Economists in the state and local area from May to July 2013. Using Indeed.com, Monster.com, and the Georgia Department of Labor Explorer, statewide job opportunities were researched while SavannahHelpWanted.com provided insight to openings in the Savannah area. With each of these websites, the search parameters were refined to remove any job openings that were not pertinent to a Business Economics degree. The search was

[1] Georgia Occupational Employment Statistics. Available at: http://explorer.dol.state.ga.us/mis/oes.htm

[2] http://www.clemson.edu/uced/workforce_projections/wfsavannah.html and http://www.us1stops.com/pdfs/strategic_plan/Upper_Savannah_Workforce_Brief.pdf

narrowed to openings listed within the last two weeks of each search cycle. This process was repeated every two weeks to prevent potential overlap of job searches.[3]

Table (2)

Source	Job Data			
	5/24/2013	6/7/2013	6/21/2013	7/2/2013
Indeed	347	298	160	161
Monster	159	163	165	155
Savannah Help Wanted	65	55	42	63
Explorer	400	379	381	334

As Table (2) indicates, there are numerous workplace opportunities for graduates with a degree in Business Economics. Also, for the month of September, the Georgia Labor Explorer shows job opportunities for 1500 analysts and 1300 management positions. Clearly, with this degree, the university system would be able to help meet the demands of the marketplace with graduates capable of making informed and optimal business and strategic management decisions. The BS in Business Economics can also help prepare students for successful careers in many different professions outside of business, e.g. government or law.

DEMAND FOR THE PROGRAM

Several USG institutions (see Table 3) simultaneously offer a BA/BS in Economics and a BBA in Economics, recognizing that students who pursue the BBA in Economics wish to develop a different skill set than students who pursue the BA in Economics. The Department of Economics at Armstrong awarded the largest number of bachelors' degrees in economics, within its 200-mile radius, from 2008-2010. The Department introduced the Business Economics track in the Fall of 2011 when the concurrent number of economics majors was 130. In September of 2012, the number of majors had grown to 167, and by September of 2013, there were 188 economics majors, 99 of whom were in the Business Economics Track (hereafter referred to as BE track). This is roughly a 45% growth in the major following the introduction of the BE track. As a result of such a growth, the average class size for all upper level economics courses, excluding internships and independent research, has increased substantially. In fact, the average class size has increased from 17 in Fall 2011 to 30 in Fall 2013, an increase of 76%. Additionally, during 2012-2013, 20 economics students took a senior capstone course required for completion of the economics degree. There are currently 48 students preregistered for these capstone courses (23 of

[3] One should note that Table (2) considers mainly occupations which require applicants with greater quantitative and analytical skills, therefore the actual job count for open positions pertinent to a Business Economics Degree is much greater than the figures suggest.
The word "analyst" in the title of each job description was searched, sorting said jobs accordingly, effectively removing any positions in the search that were not pertinent to this degree. Similarly, Monster.com was searched for "analysts" while dropping unrelated positions. The "Explorer" function in the Georgia Dept. of Labor website provided a filter to search for analysts as well. For SavannahHelpWanted.com, analyst positions were researched in the Savannah area. The search was further refined in all of these for openings within the last 14 days, allowing for update every 2 weeks, guaranteeing no accidental overlap by including the same job twice.

them BE track), suggesting our number of graduates will double, or more, in one year. As these numbers suggest, there is clearly a strong demand for the proposed major at Armstrong.

The impact of growth within the required classes for the BE track has been quite significant, as it has compelled us to overload many of these classes and also increase the number of accounting classes. In Spring 2013, for instance, a required course for the Business Economics track, ECON 3050, Intermediate Macroeconomics was overloaded by nineteen students (77%) to meet the demand of the students. Exactly half of the students enrolled in that course were BE track majors. During the same period, ECON 3500 Managerial Economics, also required for the BE track, was overloaded by 20%. Moreover, for the first time in many years, two accounting courses were offered and filled to capacity; the majority of enrolled students were on the BE track. In Fall 2013, all upper-level economics courses required for the BE track are over-filled. About 56% of students in Money and Banking are on the BE track and this course is overloaded by nine students (30%). In addition, accounting offerings were expanded to a third course in the Fall and all are nearly filled to capacity.

Further evidence of demand for the Business Economics degree was obtained from a survey of 279 students taking introductory Psychology courses in Spring 2013. These courses are among the most popular for students fulfilling their requirements in the Social Sciences Core Area E, and therefore, constitute a reasonable cross-section of the student population. In the survey, students were asked if they would be interested in choosing Business Economics as a major if they were starting their college career over. The level of interest was very high; more than 54% of students responded positively. Among those who showed interest, 58% were freshmen; 65% were sophomores and 80% were juniors.

Finally, many students transfer away from Armstrong due to the lack of availability of a Business degree. A 2011 internal report prepared by Armstrong to address retention, progression and graduation rates states that “30% of the local students, living within a 50-mile radius of campus, who did not persist at Armstrong requested transcripts” to transfer to other institutions to pursue a degree not offered at Armstrong “i.e., business, which is frequently cited by transferring students.” This clearly indicates that there is strong demand for a business degree such as Business Economics major among Armstrong students.

NON-DUPLICATION OF OTHER USG PROGRAMS

Table (3) presents a list of USG institutions that offer a degree in Economics. There are only six institutions that offer a BBA in Economics that resembles those of Armstrong’s proposed degree CIP: 52.0601) (highlighted). These institutions together graduated a total of 148 students in 2008, with over 47% of them graduating from the University of Georgia.

It should be noted that Armstrong’s proposed degree is very different from the existing programs at these institutions. First, Business Economics majors at Armstrong will be required to pursue a minor in a discipline outside of Economics. Such a requirement will provide students with enhanced contextual knowledge and understanding of a particular field and expose them to an interdisciplinary course structure that will encourage different perspectives and creative approaches to the challenges facing businesses. Thus, the degree offers students a competitive advantage as compared to other graduates with traditional business degrees.

Second, the importance of effective communication in maintaining successful job performance is becoming increasingly clear in the workplace.[4] The requirement of three communications courses in the Armstrong's proposed degree will provide students with a valuable skill in great demand in the marketplace.

Third, because many commentators attribute the recent financial crisis to unethical behavior in the financial industry, it has become even more urgent to emphasize the importance of ethical behavior in business practices.[5] The requirement of two courses in ethics in Armstrong's proposed degree will make this degree distinctly different than those of other USG institutions and will also encourage students to consider the ethical ramifications of policies, processes, and situations.

The proposed BS in Business Economics places Armstrong in a unique position as the only institution within the system that will offer a Business Economics degree grounded in the Liberal Arts tradition. Students will be exposed to a broad and diversified educational experience that fosters the development of a knowledgeable, articulate, and ethical person.

CONCLUSION

As the above demonstrates, there is a strong need and demand for the proposed Business Economics major at Armstrong. This degree focuses on a deep understanding of the economic environment within which businesses operate, with particular attention to the development of students' skills, particularly in the areas of effective communication and disciplinary-based contextual knowledge. The required minor will provide the background necessary to be successful in specific workplace environments, such as in health services, and non-profit management. Further, with the recent expansion of the knowledge-based economy, it is essential to recognize the need for producing graduates with strong analytical skills. The graduates of Armstrong's proposed Business Economics major will possess the ability to deconstruct varied economic scenarios. They will be able to apply their knowledge to various business environments and formulate optimal decisions for their future employers. The proposed Business Economics major will prepare competent graduates for the traits that are highly regarded and in demand in the private sector.

The claim that there is a strong demand for the major at Armstrong is not based on speculation, but on the observation of demonstrated need. The evidence suggests that the major will be extremely popular among students who appreciate the value of a business degree. As the survey suggests, the desire for this major among Armstrong students is also rapidly growing and it is clear the introduction of this degree will enable the university to address their demand. Moreover, Armstrong's proposed degree is unique among USG institutions, as it requires students to pursue a minor, take three communication courses and two ethics courses, all while being grounded in the strong foundation and tradition of a Liberal Arts education.

Finally, Armstrong is the only non-specialized institution in the University System of Georgia that does not offer a degree in Business. Our proposed Business Economics major is not

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[4] Morreale, Sherwyn P., Osborn, Michael M., Pearson, Judy C. (2000) "Why Communication is Important: A Rationale for the Centrality of the Study of Communication" *The Journal of the Association for Communication Administration.* Vol. 29 pp. 1-25

[5] Gregory Curtis, "The Financial crisis and the Collapse of Ethical Behavior," http://www.ritholtz.com/blog/2008/12/the-financial-crisis-and-the-collapse-of-ethical-behavior/

equivalent to a Business degree, but it does close a gap in Armstrong's curricular options. In any given year, Business is among the most popular majors at colleges and universities and, hence, is a staple degree in almost all reputable institutions of higher education. Its absence is a disservice to current students who want to earn an Armstrong degree, but must transfer if they desire to study business. Our proposed degree will offer an opportunity to students who are interested in studying economics and business within a holistic context, one that emphasizes the business world's relationship to other areas of knowledge.

Table (1)

Occupations	2010 Base Employment	2020 Projected Employment	Change in Employment
Management Occupations			
Management of Companies and Enterprises	53,580	59,970	6,390
Medical and Health Services Managers	10,420	13,060	2,640
Administrative Services Managers	10,860	12,660	1,800
Construction Managers	13,080	14,730	1,650
Financial Managers	15,760	17,360	1,600
Sales Managers	14,770	16,280	1,510
General and Operations Managers	77,470	78,940	1,470
Social and Community Service Managers	3,270	4,360	1,090
Managers, All Other	16,990	17,960	970
Marketing Managers	6,900	7,760	860
Property, Real Estate, and Community Association Managers	6,320	6,960	640
Chief Executives	20,700	21,250	550
Human Resources Managers	2,090	2,430	340
Public Relations Managers	1,740	2,050	310
Food Service Managers	7,230	7,530	300
Other Managers	14,390	15,470	1,080
Total	275,570	298,770	23,200
Analytical Occupations			
Management Analysts	46,290	53,820	7,530
Market Research Analysts	9,100	12,040	2,940
Cost Estimators	4,720	5,910	1,190
Financial Analysts	6,700	7,770	1,070
Personal Financial Advisors	6,310	7,090	780
Credit Analysts	2,360	2,860	500
Logisticians	4,210	4,700	490
Business Operations Specialist	23,250	23,610	360
Securities, Commodities, and Financial Services	4,190	4,500	310
Operations Research Analysts	2,600	2,870	270
Other analytical Occupations	4,010	4,210	200
Total	113,740	129,380	15,640

Source: Georgia Department of Labor. http://explorer.dol.state.ga.us/mis/wages.htm

Table (3)					
Institution	Miles from	*CIP	**Bach FY 2010	**Bach FY 2009	**Bach FY 2008
Georgia Institute of Technology	252	52060101 Economics BS	21	15	29
Georgia State University	248	45.060100 Economics AB	62	52	63
		45.060100 Economics BS	11	3	5
		52.060101 Economics BBA	34	37	28
University of Georgia	219	45.060105 Economics AB	68	34	36
		52.060105 Economics BBA	106	91	71
Georgia Southern University	58	45.060101 Economics AB	6	2	1
		52.060101 Economics BBA	15	8	16
Valdosta State University	181	52.060101 Economics BBA	13	8	14
Armstrong Atlantic State University	0	45.060100 Economics BA	21	27	22
Fort Valley State University	175	45.0601 Economics BA	Info not available		
		01010300 Agricultural Economics BSAG	2	1	3
Georgia College & State University	164	52.060101 Economics BS	14	6	14
		52.060101 Economics BA			
Kennesaw State University	272	52.060101 Economics	19	17	15

		BBA			
University of West Georgia	298	45.060100 Economics BS	17	12	16
		45.060500 International Economics BA	5	4	3
		52.060101 Economics BBA	5	2	4
Savannah State University	9	No Economic Degrees	Info not available		

* source: app.usg.edu/dmafinal/dma_report.dma_menu
**BOR Degrees Conferred Report:
http://www.usg.edu/research/documents/deg_conferred/deg_conferred10.pdf

Proposed BS Engineering Science

Armstrong Atlantic State University

Savannah State University

EXECUTIVE SUMMARY

The Engineering Studies program at Armstrong Atlantic State University and the Department of Engineering Technology at Savannah State University propose the implementation of a four year **Bachelor of Science in Engineering Science degree (BSES) program**.

1. The proposed program **does not duplicate any program** currently offered by public or private universities in the state of Georgia. No other program in the University System of Georgia currently offers undergraduate students a curriculum with the breadth of engineering and science courses defined within this proposed program.

2. The BSES degree is well-suited to infuse the region with workforce ready graduates as specific engineering and science course combinations may be tailored to meet local workforce needs. The BSES degree has the support of several local engineering companies, who were consulted on courses relevant to their needs.

3. Several universities throughout the United States offer an undergraduate major in engineering science in addition to the traditional specific engineering majors. Others offer similar broad based engineering degrees such as Engineering Physics or Engineering Mechanics. There is therefore a healthy demand for graduates with broad engineering and science skill-sets. Current workforce and public policy studies suggest that this demand is predicted to exponentially increase.

4. The proposed program will **not likely require new space or additional monies for equipment or software**. It optimizes the use of technology resources and engineering (or engineering technology) faculty expertise available at Armstrong Atlantic State and Savannah State University. The program has a strong potential to generate new revenue in enrollment and lab fees.

5. The BSES program may be fully accredited by the Accreditation Board of Engineering and Technology (ABET). ABET was consulted regarding the development of a program structure that would maximize the probability of successful accreditation.

6. In a 2012 internal survey, approximately 90% of current students who did not meet transfer requirements for Georgia Tech indicated they would be interested in pursuing this degree option if it were available at Armstrong/Savannah State. Sixty-seven percent of local high local school students indicated they would be interested in pursuing this degree option.

7. The demonstration of a strengthened partnership, and the fact that both universities would now jointly own a four-year engineering science degree program (as opposed to a two-year engineering transfer program), substantially increases the opportunities to submit federal and/or private proposals for STEM grants. Consequently, the likelihood of receiving federal and/or private funding for STEM education and research increases.

8. From a curriculum standpoint, it is flexible and scalable for new tracks that may split off or combine traditional engineering. It can therefore adapt more nimbly to changes in requirements dictated by the engineering industry compared to traditional programs.

9. One new staff line (laboratory technician) and the conversion of an existing staff line to a faculty line are requested to support the program at Armstrong Atlantic State University. One new faculty line is requested to support the program at Savannah State University. According to the proposed management model, a jointly appointed program coordinator would be required.

Program Description

The proposed four year Bachelor of Science in Engineering Science (BSES) degree is a multidisciplinary program that emphasizes enhanced understanding and integrated application of engineering, scientific, and mathematical principles. The joint program will be offered by combining faculty and resources within the Department of Engineering Technology at Savannah State University (SSU) and the Engineering Studies Program at Armstrong Atlantic State University.

The BSES curriculum seeks to provide a broad foundation in the sciences, engineering and associated mathematics that underlie engineering, and also gives students the opportunity to obtain depth of knowledge within a specific engineering area through technical electives. The breadth of the program is therefore balanced by depth within specific course combinations tailored to meet local industry needs. In addition to taking core courses in mathematics, physics, chemistry, and biology, engineering science students may study thermodynamics, heat transfer, electrical circuits, solid and fluid mechanics, materials science, digital design, and computer programming. While in their senior year, students complete a capstone design project using established principles of research, design, and analysis while integrating scientific and engineering concepts. Focus areas of study may include: structural systems, civil systems, ocean applications (eg. coastal energy generation), robotics, sports engineering, interdisciplinary design, industrial operations, etc. Hence engineering science students are provided breadth in engineering and science, and are therefore able to function across disciplines, graduating well prepared for advanced studies or professional employment.

BSES relative to Armstrong's mission

Armstrong currently has 300+ students enrolled in their two-year engineering transfer program to either Georgia Tech or Georgia Southern University. Armstrong's College of Science and Technology currently offers Bachelor's degrees in Biology, Chemistry, Physics, Mathematics, Psychology, Computer Science, Information Technology; a Masters degree in Computer Science, and an Associates of Science degree (engineering track). Armstrong has produced hundreds of graduates from their College of Science and Technology and provided the first two years of the traditional engineering curriculum to hundreds of graduates since 1994.

Armstrong's mission is to be a teaching-centered and student-focused institution able to provide diverse learning experiences and professional programs grounded in the liberal arts. It is well documented that 21st century scientists and engineers will need to draw from a broader range of scientific knowledge and soft skills to solve complex multifaceted technical problems of the future. The establishment of a joint BSES degree is therefore consistent with Armstrong's mission of providing a diverse learning experience and professional program grounded in liberal arts and additionally provide graduates with a solid foundation in scientific and engineering fundamentals.

BSES relative to SSU's mission

Savannah State University (SSU), the oldest public, historically black university in the State of Georgia, aims to develop productive members of a global society through high quality instruction, scholarship, research, and service and community involvement. The BSES degree will produce graduates who are work force-ready locally, nationally, and internationally; this is consistent with SSU's mission to develop productive members of a global society. The BSES degree will also provide graduates with strong analytical skills who have a broad understanding of scientific and engineering concepts. This type of intellectual foundation allows graduates to thrive in areas such as research and development, service and community leadership; an outcome that also meets and exceeds SSU's core mission. SSU currently has 200+ students in the Department of Engineering Technology. The Department currently offers Bachelor's degrees in Civil Engineering Technology, Electronics Engineering Technology, Computer Science Technology, Mathematics, and an Associates of Science (engineering studies, general technology or pre-physics).

Program Description and Goals

Institutional Priority

The establishment of a joint Armstrong/SSU BSES degree is a top priority for Armstrong Atlantic State University and Savannah State University.

The BSES program is consistent with several of the strategic goals for both institutions. SSU's strategic goal No. 1 seeks to "maximize its comparative edge through academic excellence and applied learning" while Armstrong's strategic goal No. 1 seeks to "impart the skills and habits of mind to motivated students that help them realize their potential as productive citizens of the world." The BSES program is designed to be flexible with the changing needs of the technical industry while retaining academic rigor, authenticity of purpose and maintaining consistency with current research based solutions in engineering education. It will therefore contain a strong component of applied learning, and reflect academic excellence while imparting the skills and habits of mind necessary for productive citizens.

A BSES curriculum must, by its nature, include new technology and emerging concepts that encourage transformative learning inside and outside the classroom. Additionally, students must be able to apply and expand new technologies as a necessary component of any modern engineering program. These aspects are consistent with No.2 and No. 3 of Armstrong's strategic goals, which seek to "ensure that transformative student-learning takes place inside and outside the classroom," and "expand Armstrong's technological capabilities and reach, to meet current and emerging needs," respectively. The BSES degree will be a significant expansion of current programs for both universities. SSU's strategic goal No. 2 aims to build institutional capacity through continuous improvement and expansion of academic programs and technology. Similarly, Armstrong's strategic goal No. 4 seeks to wisely invest in initiatives that support long term sustainability. The BSES is indeed a wise investment as current engineering education literature indicates that there will be a greater need for broad engineering programs to develop graduates for 21st century engineering solutions.

Both universities are part of the Regents Engineering Transfer Program (RETP) which has been in existence for 20+ years. The program provides students their first two years of engineering coursework; the completion of which enables them to transfer to the Georgia Institute of Technology to pursue an engineering degree at the Atlanta campus. Recently, Georgia Southern became a component of RETP as a receiving institution. Therefore, RETP students from Armstrong and SSU can now transfer to GSU's engineering program (albeit a lower GPA requirement) in Statesboro GA as well. Georgia Tech built a campus in Savannah, GA in 1998. Since the majority of local students found it difficult to relocate to Atlanta due to family and economic concerns, this facility allowed many more engineering students to transfer from either institution to Georgia Tech. Armstrong and SSU have a combined 400+ students enrolled in the

pre-engineering and/or the RETP transfer program. No other program at SSU has the potential to increase the number of minority graduates eligible for a broad array of professional engineering and/or science careers as significantly as the proposed BSES program.

BSES Program Objectives

Program objectives target the major outcomes expected of Engineering Science students and are flexible and readily adaptable to meet changing constituent needs. The Armstrong/SSU joint BSES program is accreditable by the Accreditation Board of Engineering and Technology (ABET) and is therefore designed to satisfy ABET outcomes (a) through (k) while incorporating additional principles necessary for a successful scientific foundation. ABET outcomes are listed below:

ABET student outcomes

BSES graduates will have:

a) an ability to apply knowledge of mathematics, science, and engineering,
b) an ability to design and conduct experiments, as well as to analyze and interpret data,
c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability,
d) an ability to be a global collaborator, capable of working effectively within culturally diverse and/or multidisciplinary teams,
e) an ability to identify, formulate, and solve engineering and scientific problems,
f) an understanding of professional and ethical responsibility,
g) an ability to communicate effectively,
h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context,
i) a recognition of the need for, and an ability to engage in professional development and lifelong learning activities including, but not limited to, the pursuit of masters, doctorate, medical, and law degrees, continuing education, leadership development, professional registration or certifications, management training, and global involvement/awareness,
j) a knowledge of contemporary issues, and
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Other Program Outcomes

The Armstrong/SSU joint BSES program has the following additional objectives:

BSES graduates will
a) Be capable of immediately meeting local, regional and national professional workforce needs in science, engineering and related technical industry positions,

b) Add value to the workforce economic potential by being leaders and innovators within their respective companies or through entrepreneurial pursuits,
c) Engage in practice in a wide variety of fields including, but not limited to, electrical systems, robotics, structural and mechanical systems, materials development, forensics, biomaterials, medicine, law, environmental systems and business,
d) Be capable of researching, developing, designing and/or utilizing new products, processes, materials, devices, systems, and/or tools; and communicating findings, best practices at conferences and meetings, filing patents, publishing (journals, reports, memoranda), and making presentations to the general public (seminars),
e) Participate in and promote the value of environmental sustainability and diversity in society,
f) Encourage and foster future generations of scientists and engineers through mentoring, service, and outreach.

STEM Funding and Other Opportunities

Undergraduate research enhances the undergraduate education experience by honing investigative, organizational, and managerial skills as well as encouraging independent analytical thinking, inquiry based learning, initiative, and self-direction. Currently, undergraduate engineering research productivity in both programs is limited to the capabilities of sophomore engineering students. The addition of junior and senior engineering science students will increase undergraduate STEM research output and quality. This in turn enhances faculty scholarly productivity resulting in greater potential and opportunities for the program to receive STEM funding.

Having new graduates in Engineering Science introduces other exciting and progressive opportunities for Armstrong's and SSU's growth. The potential for collaborative STEM efforts and more powerful engineering and technology outreach programs (community) increases substantially. Collaborative efforts optimize resource use for maximum program impact. These new partnerships will be economically advantageous to the region and the State of Georgia, in general. New alumni contributions (due to Engineering Science graduates) will also play a role in continuing or improving the quality of the program and its effect on the local region.

The multidisciplinary nature of the program has the potential to strengthen partnerships between each program and other departments such as Chemistry, Physics, Biology and Mathematics at each institution; thereby increasing STEM grant proposal activity and, ultimately, grant award activity. The Georgia Department of Education (GaDOE), The National Science Foundation (NSF), NASA and many other federal programs have made STEM education a top priority for the 21st century and have committed relatively large portions of their budgets to STEM funding compared to other programs (Presidents Council of Advisors on Science and Technology, 2010).

Need

Local Industry Needs

Southeast Georgia is home to many manufacturing, technical, and engineering companies that are strong contributors to Georgia's economic growth. The inability to recruit entry-level engineers who are willing to relocate is a common problem faced by engineering and technology companies in Savannah and surrounding areas. This inability slows rural Georgia's economic growth as the productivity of these companies is impacted by low recruitment and retention of capable entry level engineers or other technical personnel. Armstrong/SSU's joint BSES degree will contain courses relevant to the skill-set reported to be in demand by the engineering/technical companies in the region. Armstrong graduates with a BSES degree will therefore be capable of immediately filling local workforce needs.

There is no other university program within the University System of Georgia that offers students such a broad combination of engineering and science courses, with the flexibility to match local or regional industry needs.

Why Engineering Science?

There are seven key aspects of future engineering challenges which will necessitate transformative methods in the training of undergraduates (Rugarcia, Felder, Woods, & Stice, 2000):

- **Information-Proliferation**: In 1989, 10,000 volumes were required just to list the titles of all the books that had been published, and roughly 6,000 scientific articles were published every day (Meneses, 1989). The number of documents available tripled in 2000 and there is every indication that the rate of growth will be sustained if not increased. The ability to understand, manage, and deconstruct information from several disciplines using multiple sources relevant to a specific problem will be paramount for the successful technical employee.

- **Technology Development-Multidisciplinary**:
  There is now more blending across the traditional disciplinary lines than ever before. For example, engineers of all types are finding themselves with a need to understand and apply the fundamentals to areas such as electronics, biochemistry or optics. Rugarcia (Rugarcia et al, 2000) notes that, "The key to better technological development lies in cooperation among the previously separate disciplines to attack problems that have no recognizable disciplinary boundaries."

- **Markets-Globalized**: Industries in which employees are not prepared to compete globally will not likely survive. While experts are essential, the ability to be trained on emerging techniques and processes while retaining cultural and economic understanding will be the key to innovation in a global market.

- **The Environment-Endangered**: Environmental devastation due to engineering achievements such as the jet engine continues to introduce new and more complex challenges. Engineers now need to incorporate renewable sources, sustainability concepts, and environmental hazardous effects in all design problems. An understanding of traditionally scientific areas such as bacteria, plant biology, the human immune system etc., will be needed for successful design outcomes.

- **Corporate Structures-Participatory**: Companies are increasingly asking their technical staff to participate in the decision making related to management, operations and marketing. Corporate entities also seek to participate in curriculum development and education policy.

- **Social Responsibility-Emerging**: The social consequences of engineered systems design can no longer be relegated to the world of insignificance or trivial afterthought. Consequently, designers with broader scientific knowledge are a necessary component of engineering teams so that solutions with cultural and social repercussions can be comprehensively evaluated.

- **Change-Rapid**: While a component of the BSES program will attempt to maintain pace with local industry needs, change is often so rapid that the majority of any new technological program should equip students with the skills needed to adapt to rapid technological change. The BSES graduate is well-equipped for lifelong learning and adaptability to change as they will be well-versed in scientific inquiry as well as the fundamentals of a broad range of current technologies and techniques.

These seven phenomena are not new; however, their rate of growth has been increasing exponentially within the last two decades. As early as 1987, Felder recognized these phenomena and suggested that the traditional one-size-fits-all curriculum model be modified to institute multiple tracks for different areas of specialization, relegating some traditionally required courses to the elective category (Felder, 1987). That author went on to suggest that, “No matter how many parallel tracks and elective courses are offered, however, it will never be possible to teach engineering students everything they will be required to know when they go to work. Another suggested solution was to shift our emphasis away from providing training in an ever-increasing number of specialty areas to providing a core set of science and engineering fundamentals helping students integrate knowledge across courses and disciplines, and equipping them with lifelong learning skills (Prausnitz, 1988).

Several approaches have been taken to help meet the aforementioned challenges. For example, the Department of Civil Engineering and Geological Sciences at the University of Notre Dame offers a unique blend of traditional engineering and science disciplines to address many of the 21st century grand challenges facing society, including environment, energy, infrastructure, and water. The “3-2 combined degree” plan where students obtain an engineering degree from one institution and a science degree from another in five years is fairly common throughout the

United States. This type of program is not just beneficial to the institutions involved, students graduate with a specialty in engineering and a strong foundation in science; a background which allows them to tackle multidisciplinary problems that might be more difficult for a graduate in a single traditional engineering discipline.

Engineering vs Engineering Science vs Engineering Technology

Engineering, Engineering Science, and Engineering Technology programs are quite distinct from one another in objectives, curricula, expected expertise and job functions. As such the Accreditation Board of Engineering and Technology (ABET) has different committees and rules for the accreditation of engineering and engineering technology programs. While the same committee accredits specialized engineering and engineering science programs, the accreditation protocol for specialized engineering programs has many additional requirements. Georgia Southern University, Georgia Institute of Technology and the University of Georgia all offer BS degrees in Mechanical Engineering (BSME) among many other specialties, while Southern Polytechnic State University offers a Bachelor of Science in Mechanical Engineering Technology (BSMET). In order to elucidate the differences, the characteristics of each program are compared in the subsequent section.

Comparison of BSME, BSMET, BSES (possible mechanics track) Program

Our proposed program allows broad coverage of diverse engineering topics, leaving open the option for tracks tailored specifically for local industry needs. For the purposes of comparison, the BSES degree discussed below contains a potential mechanics track that could be recommended by the adviser after consultation with local industry.

Program Guide Characteristics

BSME: An innovator - one who is able to interweave a knowledge of advanced mathematics, the natural and engineering sciences, and engineering principles and practices with considerations of economic, social, environmental, and ethical issues to create new systems and products. An engineer can develop new procedures within mechanical engineering to advance the state of the art. The BSME graduate solves new problems, often ill-posed, typically within the traditional mechanical systems (eg. hydraulics/pumps, escalator/elevator systems, HVAC systems, gears/shafts, engines, vehicle performance, machine design etc.)

BSES: An innovator (multi-disciplinary) - one who is able to think analytically across technical disciplines and tackle future technical challenges that require a broader understanding of the natural sciences and advanced mathematics combined with some traditional engineering areas. **The BSES graduate will have a broader science and more diverse engineering background coupled with limited depth in an emerging area;** the engineering scientist also has the foundation to create new multi-faceted systems that may have mechanical, biological, chemical, or electrical components. Examples of engineering science areas might include: alternative energy systems (eg. biofuels), hybrid system interfaces and controls (energy, human/robot interface), waste solutions for emerging or traditional systems, accident investigation (structural, electrical, chemical), failure analysis (electromechanical, chemical), project engineering, process engineering, medical device engineering, mechatronics, laser, and packaging engineering.

BSMET: A doer or implementer - one who is able to apply a basic knowledge of mathematics, the natural and engineering sciences, current engineering practices, and an understanding of economic principles to the operation, testing, maintenance, reconstruction, conversion of engineering and manufacturing systems. The engineering technologist can apply established procedures (developed by engineers) which utilize the current state of the art equipment (designed by engineers). Examples of mechanical engineering technology areas might include: manufacturing technician, automotive technician, automotive engineer, logistics manager, materials manager, maintenance engineer, manufacturing engineer, production engineer, reliability and testing engineer, systems support technician, technical engineer, and quality assurance assistant.

Program Objectives

BSME: To provide the knowledge necessary to design, manufacture, and maintain state of the art products and systems needed to meet the current and future needs of society. To provide the knowledge required to apply state-of-the-art techniques and designs to meet the current needs of society.

BSES: To provide the knowledge that combines an understanding of the physical/life sciences with engineering analysis and design, in order to solve interdisciplinary design problems.

BSMET: To provide the knowledge required to apply state-of-the-art techniques and designs to meet the current needs of society design and maintenance problems.

Program Emphasis

BSME: Emphasis is placed on developing methods of analysis and solutions for open ended mechanical engineering problems.

BSES: Emphasis is placed on understanding the fundamentals of a broad variety of engineering and science fields in order to develop solutions for emerging problems that encompass both scientific and engineering disciplines.

BSMET: Emphasis is placed on applying current knowledge and practices to the solution of specific technical problems.

Expertise Objectives

BSME: To develop conceptual and analytical abilities and apply them towards open ended mechanical systems design.

BSES: To develop conceptual and analytical abilities and apply them towards open ended, non-traditional interdisciplinary problems.

BSMET: To develop “hands on” application abilities for the operation and maintenance of existing mechanical systems.

Program Length

BSME: Four years.

BSES: Four years.

BSMET: Four years. Transfer students from community colleges will take longer if they do not have basic math and science prerequisites for freshman courses.

Emphasis of Technical Courses

BSME: Engineering courses stress the underlying theory which are applied to the design, development and testing of mechanical systems in business and industry.

BSES: Engineering and science courses stress underlying theories; problems and solutions examined are less specialized and more interdisciplinary compared to BSME.

BSMET: Technology courses stress the application of technical knowledge and methods in the solution of current industrial problems.

Emphasis of Laboratory Courses

BSME: Laboratory courses provide an intensive overview of experimental methods and of the related underlying theories (20% of coursework).

BSES: Laboratory courses provide an intensive overview of experimental methods and of the related underlying theories (30% of coursework- additional science labs).

BSMET: Laboratory courses, an integral component of ET programs, stress practical maintenance solutions (60% of coursework).

Academic Terminology

BSME: Graduates are referred to as engineers.

BSES: Graduates who go into engineering will be referred to as engineers; many graduates will go into general or emerging areas with titles such as project engineer, test engineer (fire), process engineer.

BSME: Graduates are referred to as engineering technologists, however, job titles after entering industry will be “engineers” more often than not. Most graduates end up in highly specialized application areas such as maintenance of automated manufacturing equipment, energy systems (turbines, pumps, heat exchangers).

PE license

BSME: Yes, 4 years after working in the field and passing FE examination.

BSES: Yes, 4 years after working in the field and passing FE examination.

BSMET: Yes, 7 years after working in the field and passing FE exam. Engineering Technology graduates typically need additional coursework or seminars in order to pass the FE exam. Employers who require their engineers to hold a PE license will generally prefer to hire graduates with and engineering degree (as opposed to engineering technology) because it is in the company's best financial interest that their engineers obtain professional licensures as soon as possible.

ABET Accreditation

BSME: Yes, by the Engineering Accreditation Commission EAC component of the ABET.

BSES: Yes, by the Engineering Accreditation Commission EAC component of the ABET.

BSMET: Yes, by the Technology Accreditation Commission (TAC) component of the ABET.

Table 1 provides a course comparison between hypothetical BSME and BSES programs. It is observed that a BSES graduate has a substantially broader engineering and science background compared to a BSME graduate. For example, while the BSME student takes 16 courses (51 hrs, exclude technical writing and two non-mech. electives) tailored for the mechanical engineering field with one additional science course, the BSES student would take six courses (18 hrs shown in red) in the ME field with the option of doing four other courses in related engineering areas (12 hrs), the BSES student would also have seven additional courses (21 hrs) that may be chosen from Science, Engineering or Mathematics (SEM). Note the BSES's student capstone design project may be tailored for ME systems; however, this final design project would typically incorporate multiple branches of engineering and science. Elective options are provided in the curriculum section of this proposal (page 20).

Table 1 Comparison of BSME with BSES technical courses (core science and math courses are the same and therefore excluded)

2nd year Fall			
MSE 2001 Principles & Applications of Engineering Materials	3		
ME 2110 Creative Decisions And Design	3	SEM elective	3
COE 2001 Statics	2	ENGR2001 Statics	3
2rd year Spring			
ME 2202 Dynamics of Rigid Bodies	3	ENGR2110 Creative Decisions and Design	3
ME 2016 Computing Techniques	3	ENGR3322 Thermodynamics	3
Science Elective (BIOL, CHEM, EAS, PHYS)	3	SEM elective	3
ECE 3710 Circuits & Electronics	2		
3rd year Fall			
ME 3322 Thermodynamics	3	ENGR 3100 Circuits & Electronics	3
ME 3340 Fluid Mechanics	3	SEM elective	3
COE 3001 Mechanics of Deformable Bodies	3		
ECE 3741 Instrumentation & electronics lab	1		
3rd year spring			
ME 3015 System Dynamics & Control	4	STAT 3211 Prob and Stat I	3
ME 3345 Heat Transfer	3	SEM elective	3
CEE / MATH / ISYE 3770 Statistics & Applications	3	UL Engineering elective	3
ISYE 3025 Essentials of Engineering Economy	1	UL Engineering elective	3
4th year fall			
ME 3057 Experimental Methodology & Technical writing	3	UL Engineering Elective	3
ME 3180 Machine Design or ME 4315 Energy Systems Analysis and Design	3	UL SEM elective	3
ME 4210 Manufacturing Processes & Engineering	3	UL SEM elective	3
Mechanical Engineering Elective	3	ENGR3041 Structures Lab	2
4th year spring			
ME 4053 Mechanical Engineering Systems Laboratory	2	ENGR 4110 Capstone Design (3)	4
ME 4182 Capstone Design	3	UL Engineering Elective	3
Mechanical Engineering Elective	3	UL SEM Elective	3

There are current and future needs for all three groups (BSME, BSES, BSMET). However, current engineering education literature indicates that future solutions will depend on an ability to innovate and to develop new technical solutions to complex interdisciplinary problems. For example, increased population growth will create unprecedented demands for energy, food, land,

water, transportation, materials, waste disposal, earth moving, health care, environmental cleanup, telecommunication, and infrastructure. The multi-faceted engineering solutions will be best served by a combination of experts in the traditional engineering fields and the general engineer with a broad background in sciences. The export of engineering and other highly technical jobs by American companies to China and India appears to be a growing problem; many argue that this phenomenon threatens economic growth and national security. The need for graduates who are able to innovate, and analyze systems across disciplines at their highest levels, and develop new and cost effective solutions, is greater now than ever before.

Local Support

The companies and programs below have indicated support for the proposed BSES program.

1. Mitsubishi Power Systems, Pooler, GA
2. Thomas and Hutton Engineering Services, Savannah, GA
3. EMC engineering, Savannah, GA
4. ECS Southeast, LLC., Savannah, GA
5. EFACEC, Rincon, GA
6. Hussey, Gay, Bell & DeYoung, Inc, Savannah, GA
7. Savannah Chatham County School System, Savannah, GA

Several other larger local companies indicated support for the BSES program; however, these companies could not go on record through written documentation for legal reasons.

National Needs

A BSES degree specifically offered in this region tackles several national STEM challenges. Many emerging engineering fields require specialized training beyond the traditionally defined engineering disciplines. In these cases, a broad background in engineering is the dominant criterion which demonstrates to a company a candidate's potential to efficiently acquire some newly defined skill-set necessary for productivity. There are more interdisciplinary fields emerging than ever before and this trend is expected to continue (Simpson, Barton, & Solento, 2008). Additionally, requirements within traditional engineering fields are evolving as traditional majors are asked to explore and innovate to solve new problems (Bar-Cohen, 2005). The BSES degree offers the breadth in sciences and engineering that provides a student the flexibility to be recruited by companies who will ultimately train their entry-level engineers or technical staff for the diverse tasks and skills not taught in the traditional specialties. Examples of these types of positions are presented in Appendix A.

Of the 30 fastest-growing occupations projected through 2016, the U.S. Bureau of Labor Statistics' Occupational Outlook Handbook concludes that 16 of them will require substantial mathematics or science preparation. According to a study done by the National Science

Foundation in 2008, the United States ranked 20th among all nations in the proportion of 24-year-olds who earn degrees in natural science or engineering. Once a leader in STEM education, the United States is now far behind many countries on several measures (Kuenzi, 2008). In December 2011, the Commerce Department released a report concluding that more federal support for basic research, education, and infrastructure is needed in order for the U.S. to regain its lead on innovation. That edge has eroded over the past decade, contributing to slower economic growth (US Chamber of Commerce, 2012). This program will satisfy a national need for economic growth by stimulating innovation through the production of more graduates who are capable in the natural sciences and engineering.

In 2008, 26% of U.S. residents between ages 20 and 70 classified themselves as Hispanics, African American, or American Indians/Alaska Natives. However only 9% of workers in Science and Engineering (S&E) occupations and 11% of S&E degree holders belonged to these populations combined. Clearly, these groups are under-represented in the S&E workforce. Female scientists and engineers are concentrated in different occupations than are men, with relatively high shares of women in the social sciences (53%) and biological and medical sciences (51%) and relatively low shares in engineering (13%) and computer and mathematical sciences (26%). Armstrong recruits the majority of its students from the Chatham county population, of which 40.1% are minorities and 51.8% female. Currently Armstrong's student population is comprised of 65.8% females and 35.3% minorities. While African Americans account for 13% of the population, only 3% of full time employed engineers were African American in 2003 (Lisa M. Frehill, 2008). The trend does not differ significantly for women and other minorities.
SSU is, of course, a historically black college. Therefore, assuming recruiting practices remain largely unaltered, Armstrong/SSU's BSES program is well poised to improve the national statistic regarding the low numbers of women and minorities in S&E.

A quick search of any of the popular job search websites (eg. careerbuilder.com) with the words "engineer" and "science" as the search criteria will yield thousands of jobs per city with titles such as: quality engineer, test engineer, field service engineer, process engineer, systems engineer. The educational requirement section may list several degree types for a single position. For example, an entry level failure analysis engineer requirement may be a Bachelors degree in Electrical Engineering, Chemical Engineering, Engineering Physics or Materials Science. This demonstrates that for many positions out there, specialization is less important compared to solid fundamental engineering skills that can be fine-tuned for the specific tasks unique to the engineering requirements/process for each company.

Curriculum

The BSES program details and curriculum is provided below and summarized in Table 2. Note only Armstrong courses are listed; the majority of the courses listed have course equivalencies at Savannah State University. As the program is a joint degree, all SSU course equivalencies are accepted by Armstrong for the joint Armstrong/SSU BSES degree. The broad engineering nature of the degree results in several choices among ten technical, science or engineering elective slots.

Bachelor of Science in Engineering Science

PROGRAM FOR THE DEGREE OF BACHELOR OF SCIENCE IN ENGINEERING SCIENCE

A. General Requirements

Core Areas A, B, C, D, and E ..... 42 hours

Engineering Science majors are required to take MATH 1161 in core area A, MATH 2072 in core area D, PHYS 2211K and PHYS 2212K in core area D

Area F ..... 18 hours

One hour excess for MATH 1161 from area A

One hour excess for MATH 2072 from Area D

CHEM 1211/1211L-Principles of Chemistry I

ENGR1100 - Introduction to Engineering

ENGR 1170/1170L - Engineering Graphics

ENGR 1371 - Computing for Engineers

MATH 2083 - Calculus III

Physical Education ..... 3 hours

First Year Seminar……..…….. 1 hour

B. Major Field Courses ..... 30 hours

ENGR 2001 - Statics

ENGR 2110 - Creative Decisions and Design

ENGR 3100 - Electrical Circuits

ENGR 3322 - Fundamentals of Thermodynamics

ENGR 4110 - Senior Capstone Design

ENGR 3741 - Instrumentation and Electronic Measurement or ENGR 3145 Structures Lab

Twelve hours of Upper Level (UL) engineering courses selected from:

ENGR 3211- Electronics, ENGR 3220 - Mechanics of Materials, ENGR 3230 - Fluid Mechanics, ENGR 3320 - Heat Transfer, ENGR– Electromagnetism, ENGR 4125*-Structural Mechanics, ENGR 3515*-Systems and Controls, ENGR-Scientific Measurement . * new courses

C. Related Field Courses ..... 30 hours

STAT 3211-Probability and Statistics Applications I

MATH 3411-Differential Equations

MATH 2160-Linear Algebra

21 hours (9 hours at the 3000 level or higher) selected from approved SEM courses:

1000-2000 level

ENGR 2025 – Introduction to Signal Processing , ENGR2010 - Computational Modeling, ENGR 2030 - Introduction to Computer Engineering, ENGR 2035- Programming for Hardware/Software Systems, ENGR 2036- Engineering Software Design, ENGR 2202 – Dynamics, ENGR 2030 - Digital Design Lab, ENGR 2000 - Material Science and Engineering, CSCI 1302 - Programming Principles II, CSCI 2410 - Data Structures, CSCI 2625 - Discrete Structures for Computer Science, CSCI 2490-C++ programming, BIOL 1107 - Principles of Biology I, BIOL 1108- Principles of Biology II, BIOL 2081-Human Anatomy and Physiology, CHEM1212-Principles of Chemistry II, CHEM 2101/2101L - Organic Chemistry I and lab, CHEM 2300 - Principles of Chemical Analysis, MATH2160-Linear Algebra

3000-4000 level

CSCI3301 Unix and Secure Web development, CSCI 3330 - Comparative Languages, CSCI 3202 - Computer Organization and Architecture CSCI 3370 - Human Computer Interaction, CSCI 3341 - Introduction to Operating Systems, CSCI3720 - Database Systems, CSCI5210U - High Performance Computing, CSCI 5220U – Networks, CSCI5360U - Embedded Systems Programming, CSCI5700U - Computer Security, CSCI 5820U - Machine Learning, CSCI 5825U - Artificial Intelligence, CSCI 5830U - Computer Graphics, MATH 3000 - Introduction to Mathematical Proof, MATH 3480 – Optimization, MATH 4610 - Numerical Analysis, MATH 4060 - Functions of a Complex Variable, STAT 3222 - Probability and Statistics Applications II, STAT3231-Mathematical Statistics I, STAT 3240 - Experimental Design, CHEM 3100 - Forensic Chemistry, PHYS 3300 Thermodynamics, PHYS 3210-Intermediate Mechanics, PHYS 3700K – Optics, PHYS 3801K - Modern Physics, PHYS3400-Chemical Thermodynamics, PHYS 4170 - Advanced Mechanics

D. Electives ..... none

Total Semester Hours 124 hours (including FYSS and PE)

E. Exit Exam

Note: If courses chosen in Area B1 and B2 are three credit hours each, total semester hours will be 126 hrs (including FYSS and PE)

Table 2: Bachelor of Science in Engineering Science Suggested Four Year Course Schedule

Freshman Year	
Fall Semester	**Spring Semester**
ENGL 1101 English I (3) ENGR 1170/1170L Engr. Graphics (3) ENGR 1100 Intro Engr. (2) MATH 1161 Calculus I (4) CHEM 1211/1211L Chemistry I (4) FYS 1100 First Year Experience (1) 17 hours	ENGL 1102 English II (3) ENGR 1371 Computing for Engineers (3) MATH 2072 Calculus II (4) PHYS 2211K Physics I (4) Core course E3 (3) 17 hours
Sophomore Year	
Fall Semester	**Spring Semester**
ENGR 2001 Statics (3) Approved SEM elective (3) PHYS 2212K Physics II (4) MATH 2083 Calculus III (4) Core course C2 (3) 17 hours	ENGR 2110 Creative Decisions and Design (3) ENGR 3322 Fundamentals of Thermodynamics (3) MATH 2160 Linear Algebra (3) Approved SEM elective (3) Core course E1 (3) 15 hours
Junior Year	
Fall Semester	**Spring Semester**
ENGR 3100 Circuit Analysis (3)	STAT 3211 Prob. and Stat I (3)

Core course C1 (3) Approved SEM elective (3) MATH 3411 Differential Eqn. (3) Core course E2 (3) 15 hours	Core course B1 (2-3) UL Engineering Elective (3) Approved SEM elective (3) UL Engr. Elective (3) 14-15 hours
Senior Year	
Fall Semester	**Spring Semester**
ENGR 3741 Instrumentation and Electronic Measurement *(2) or ENGR3145 Structures Lab (2)* Approved SEM elective (3) UL Engr. Elective (3) Approved SEM elective (3) PE (3) 14 hours	ENGR 4110 Senior Capstone Design* (4) UL Engineering Elective (3) Core course E4 (3) Approved SEM elective (3) Core course B2 (2-3) 15-16 hours

*ENGR 4110, 3741, 3145 are new courses, *ENGR1100 is a modified course

120 -122 hours (+3hrs PE and 1 hr FYS 1100)

New or Modified Courses

The following would be new courses (or modified current courses). Descriptions are provided in Appendix A.

ENGR 4110 - Senior Capstone Design 1-3-3 (new)

ENGR 1100 - Introduction to Engineering 1-2-2 (modified)

ENGR 4125 - Structural Mechanics 3-0-3 (new)

ENGR 3515 - Systems and Controls 3-0-3 (new)

ENGR 3145 - Structures Lab 1-2-2 (new)

ENGR 3741 - Instrumentation and Electronic Measurement 1-2-2 (new)

Program Hours

The University System of Georgia requires the following:

"A baccalaureate degree must contain a minimum of 120 semester hours and may not exceed the minimum exclusive of physical education activity, basic health, or orientation courses that the institution may require. A baccalaureate degree program must require at least 21 semester hours of upper division courses in the major field and at least 39 semester hours of upper division work overall. Exceptions to the 120 semester-hour baccalaureate rule must be made in the form of a request for Board approval to increase credit hours in the program."

The BSES contains 120 semester hours plus three hours of physical education activities and a one hour first year experience course. (See Table 2) There are 24 hours of upper division courses in the major field and 39 semester hours of upper division work. Courses are shown in Table 3 below.

Table 3 Upper level and major courses

Course	**Credit hour**
ENGR3100 Circuit Analysis	3
ENGR 3322 - Fundamentals of Thermodynamics	3
ENGR 4110 - Senior Capstone Design	4
ENGR 3741 - Instrumentation and Electronic Measurement or ENGR3145 Structures Lab	2
Upper Level Engineering electives	12
Total Upper Level Major Field Courses	**24**
Upper level SEM electives	9
STAT 3211-Probability and Statistics Applications I	3
MATH 3411-Differential Equations	3
Total Upper Division Work	**39**

Admissions Criteria

The pre-engineering admissions criteria would be the same criteria needed for admission to either institution. For admission to the BSES program, students have to be in good academic standing with a grade of C or better in all lower level major courses.

SSU's admissions office requires the following:

- SAT: Critical Thinking 430/Math 400
- ACT: English 17/Math 17
- Academic Grade Point Average 2.3

For Students who graduate from high school in 2012 or later:

Complete the required 17 Required High School Curriculum courses:

- English - 4 Units (Grammar and usage, Literature (American and World), Advanced composition skills)
- Mathematics - 4 Units (including Algebra I, Algebra II, and Geometry and also a course at the level of Math 3 or higher).
- Science - 4 Units (Physical Science, at least one laboratory course from Life Science and one laboratory course from Physical Sciences, one biology, and one chemistry, physics or environmental science course).
- Social Science - 3 Units (American History, World History, economics (1/2 unit) and government (1/2units) at least one course should focus on U.S. Studies and one course on World Studies).
- Foreign Language - 2 Units (2 Years of Same Language

For students that graduated high school prior to 2012:

16 Required High School Curriculum (CPC) units (4 math courses; 3 sciences; 3 social sciences; 2 years of the same foreign language).

In addition to completing the above requirements an applicant must meet the following requirements, for full admissions (regular); satisfy the minimum test requirements of a 430 SAT I verbal score (ACT 17) and a 400 SAT I math score (ACT 17) and earn a Freshmen Index (FI) of at least 1940.

Armstrong's admissions office requires the following:

- SAT Minimum Scores Combined Score 900 (Critical Reading and Math only), Critical Reading 440, Math 410
- ACT Minimum Scores: English 18/Math 18
- High School Core GPA: Minimum 2.5 (Grade Point Average)

Georgia High School Minimum Core Credits

- English 4 years
- Mathematics 4 years
- Two courses in algebra, one course in geometry and one course in advanced mathematics
- Science 4 years
    - physical science, two laboratory courses from biology, physics, or chemistry, and a fourth science
- Social Studies 3 years
- Foreign Language 2 years (two years of the same foreign language)
- Freshman Index of 2006

In addition to meeting the above admission criteria, applicants graduating (or who would have graduated from high school) within the past five years must meet the requirements of the college preparatory curriculum (CPC) of the Board of Regents.

SAT Freshman Index Combined SAT I scores + (High School Grade Point Average x 500) ACT Freshman Index (High School Grade Point Average x 500) + (ACT Composite x 42) + 88
NOTE: The high school grade point average is calculated only on CPC coursework required for admission.

Program Administration

There are two models that may be considered.

(1) Individual university protocols remain unchanged; however, faculty and administration within both engineering programs are re-assigned responsibilities critical to the success of the program. It would be desirable to have a coordinator/director jointly appointed to both institutions. University of Missouri and Washington University have a joint program that approaches this structure, however, the majority of engineering courses are taught by

one university. In the model under consideration, engineering courses would be shared by both institutions. This would be different from the existing administrative structure used by any College in the University System of Georgia. The management structure may be as shown in Figure 1.

(2) Florida Agricultural and Mechanical University (FAMU) and Florida State University (FSU) have a joint engineering program in which departments have physically and administratively merged into a single College of Engineering. In the FAMU/FSU model, the College of Engineering is led by a dean, two associate deans and five supporting department heads. This model also contains approximately 135 other staff or administrative supporting positions for a student body of 2600. FAMU/FSU College of Engineering grew from 35 students in 1983 to approximately 2600 at present.

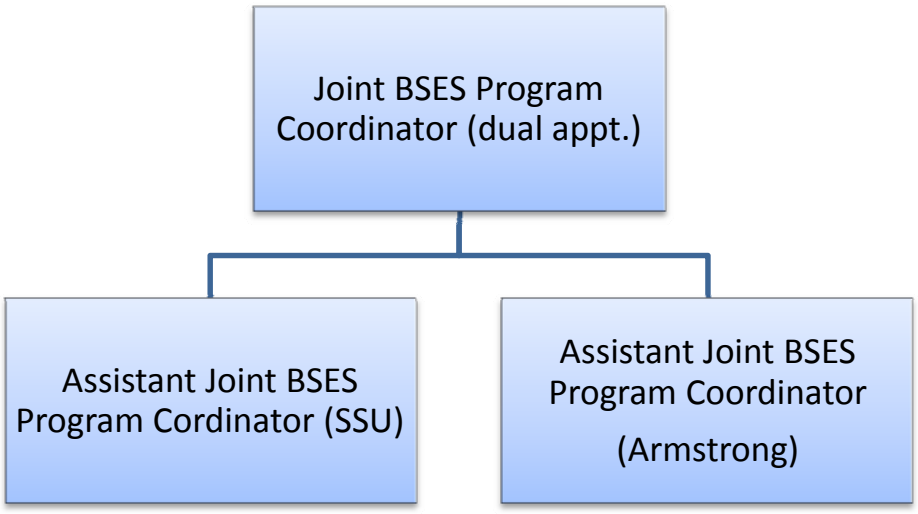

Figure 1: Option 1 Management Structure

The responsibilities are as follows:
Joint BSES Program Coordinator: responsible for assessment, accreditation, maintaining local business relationships/partnerships, projections, budget, overall program success, reports to the provosts for both institutions.

Joint BSES Assistant Coordinator at each institution: responsible for curriculum changes, transfer equivalencies, cross-registration, course rotations and schedule (2+2 reduced teaching load), faculty evaluations (separate for each institution), purchases.

Listed below are the pros and cons of both models:

Option 1

Pros

- Small initial investment (relative to option 2),
- May be done immediately with minor changes to existing infrastructure
- University transactions for each institution easier (e.g. curriculum changes)
- Little to no change to existing policies for faculty (tenure-promotion, service, teaching)
- Substantially less changes to current assessment methods besides merging on paper
- Allows time for system understanding and learning by needing only incremental changes
- Can subsequently transition to FAMU/FSU model

Cons

- Unproven management model
- More difficult to receive accreditation and perform assessment tasks
- More difficult to promote faculty interaction and partnerships (compared to FAMU/FSU model)
- Students may be less unified, less knowledgeable regarding their colleagues/cohort; this may decrease opportunities for collaborative projects, perhaps lowers student loyalty after graduation etc.

Option 2

Pros

- Proven management model
- More efficient communication, easier to get departmental administrative tasks accomplished (dept. chair-faculty communication),
- Easier to promote faculty interaction, partnerships, grants (research, teaching, engineering program committees)
- Easier to perform accreditation tasks, e.g. student records/tracking, curriculum oversight
- Strong student cohorts, unification and awareness of other students
- Easier to organize student programs, e.g. engineering competitions, student clubs

Cons

- Large initial investment, finding a suitable building, purchasing/renting or new construction may be needed, dislocating existing faculty if building is in use, relocating current engineering faculty, organizing offices, cost of overhead, computers and equipment (some may be transferred from existing programs)

- University administrative tasks more complex-e.g. payroll, human resources, ITS resources; will need to align common documents e.g. CIR'S, AFE's, DWF reports, FAR'S, other assessment data- reports/etc., Would go to which dean/provost?
- Most likely more difficult to implement from a structural standpoint –leadership structure, compensation uniformity, budget etc.
- Evaluation mechanism for tenure/promotion? (starting several new processes/standards)
- Processes at both institutions will need substantial changes e.g. registration, financial aid, course substitutions

Delivery and Location

The program will be located on the campuses of Armstrong Atlantic and Savannah State University. Students who enroll in the pre-engineering program at each institution may take their core courses at either campus or any online equivalent course offered by either university. Once students have met pre-engineering requirements, they will qualify to enter into the joint BSES program. Students enrolled in the Armstrong/SSU BSES program will take science and engineering requirements at both institutions. The course rotation will be designed such that students in their last two years will generally take 30% to 40% of their coursework on the partner campus (or via online or distance learning from the partner campus). **Note that the amount of time a student spends at their non-home university will be heavily dependent on the career path they are interested in.** Several engineering and science courses will be offered via distance learning by both institutions to minimize intercampus commutes. Courses that lend themselves to online delivery will also be offered by both institutions. We anticipate 3-4 courses could be offered in one or both of these formats after the first two years of program establishment. Table 4 illustrates a possible scenario in which some courses can be shared while others will belong to only one particular university.

Table 4 Course Offerings at Each Institution

Course type	Armstrong	SSU	Both
Core Courses			Core courses
1000 level mandatory engineering			ENGR 1100, ENGR 1170, ENGR1371
2000 level mandatory engineering	ENGR2110		ENGR 2001
Upper level mandatory	ENGR3322, ENGR3100	ENGR3145, ENGR3741	ENGR4110
Statistics	STAT3211	MATH3201	
Material Mechanics:	ENGR4125	ENGR3220	ENGR2202, ENGR2000, ENGR2010
Thermal and Fluids:	ENGR3320	ENGR3230	
Electrical Systems* ,	ENGR 2035, ENGR 2036, ENGR3515, ENGR3100, PHYS3312	ENGR3211, ENGR3041	ENGR 2025, ENGR 2030, ENGR 2031
Civil/Environmental systems*		ENGR3000	
Design	ENGR2110		ENGR4110

* Savannah State has several Civil Engineering Technology and Electronic Engineering Technology courses that may be converted to engineering courses at a later date.

Similar Programs, Specialization vs. General

Several universities across the United States have similar programs; these are shown in Table 5. The relevant engineering websites are listed in bullet format below Table 5. Note some of these programs offer traditional majors as well. This indicates that, while there is a demand for traditional specializations in engineering, there is also a demand for engineers who have a broader repertoire of interdisciplinary skills. Many other programs offer an Engineering Science and Mechanics degree which is similar to an Engineering Science degree with a mechanics track.

ES programs across the US enroll between 0.5% and 20% of their general student population. Trinity University appears most similar to Armstrong and SSU as it does not offer competing

engineering degrees and has a relatively small student population. The ES enrollment at Trinity University is approximately 7% of the overall student population.

Table 5 Existing Undergraduate Programs in Engineering Science across the US

University	University Undergrad. Enrollment	College or School of Engr. Enrollment (Undergrad.)	Engr. Science Majors	Grad. Program available	Offers traditional majors as well	Required credit hrs for degree completion	ABET
Penn State University, University Park	63732	8694	90	Y	Y	131	Y
Stony Brook University, Stony Brook, NY	16,342	1755	188	Y	Y	130	Y
Trinity University, San Antonio TX	2,500	175	175	N	N	129	Y
University of California-Berkeley	25540	3333	163	Y	Y	120	N
University of Pittsburg (Swanson School of Engineering)	25315	2157	16	Y	Y	130	Y
College of Staten Island (City University of New York)	12829	95	95	N	N	133	Y
*Virginia Tech, VA	23690	6362	99	Y	Y	131	N
SweetBriar College, VA	747	Na	Na	N	N	120	Y
Newark College of Engineering (New Jersey Institute of Technology)	6103	1968	19	Y	Y	130	N

*Engineering Science and Mechanics

Relevant Engineering Science websites for universities listed in Table 5:

- Penn State University, University Park: http://www.esm.psu.edu/about/whatisesci
- Stony Brook University, Stony Brook, NY: http://www.matscieng.sunysb.edu/undergraduate.html
- Trinity University, San Antonio TX: http://web.trinity.edu/x6156.xml
- University of California-Berkeley: http://coe.berkeley.edu/departments/engineering-science
- University of Pittsburg: http://www.engineering.pitt.edu/engineeringscience/

- College of Staten Island: http://www.csi.cuny.edu/catalog/undergraduate/undergradctlg.php4?info_tag=offerings_engineering_science
- Virginia Tech, VA: http://www.esm.vt.edu/
- SweetBriar College, VA: http://sbc.edu/engineering/engineering-science-major
- Newark College of Engineering (New Jersey Institute of Technology): http://nce.njit.edu/nceprograms/engineeringscience/index.php

ABET Accreditation, Georgia PE license

A BSES degree may be accredited by the Engineering Accreditation Commission (EAC) component of the Accreditation Board of Engineering and Technology (ABET). Upon program accreditation, students who have completed or are near completion of the ES curriculum may take the Fundamentals of Engineering (FE) examination and, subsequently, sit for their Georgia Professional Engineering (PE) license after four years of industry experience. Accreditation also allows PE's to practice and be licensed in other states. Armstrong/SSU's BSES degree program, when accredited, would serve to increase the number and educational diversity of Georgia's licensed Professional Engineers. This translates to a greater potential for economic growth and stability for the State of Georgia.

ABET criteria

ABET has eight general criteria for the accreditation of Engineering Science programs.

Criterion 1. Students: Student performance must be evaluated. Student progress must be monitored to foster success in attaining student outcomes, thereby enabling graduates to attain program educational objectives. Students must be advised regarding curriculum and career matters. The program must have and enforce policies for accepting both new and transfer students, awarding appropriate academic credit for courses taken at other institutions, and awarding appropriate academic credit for work in lieu of courses taken at the institution. The program must have and enforce procedures to ensure and document that students who graduate meet all graduation requirements.

Armstrong/SSU response: Armstrong and SSU already have these policies and practices in place for the current engineering studies and engineering technology programs, respectively, for the satisfaction of Southern Association of Colleges and Schools (SACS) accreditation. Student evaluations, progress, advising, transfer policies, etc., will be adjusted to accommodate the four-year BSES curriculum.

Criterion 2. Program Educational Objectives: The program must have published program educational objectives that are consistent with the mission of the institution, the needs of the program's various constituencies, and these criteria. There must be a documented and effective

process, involving program constituencies, for the periodic review and revision of these program educational objectives.

Armstrong/SSU response: The engineering studies programs at both universities have established the new BSES objectives, which are consistent with the missions of Armstrong Atlantic State University and Savannah State University. There are currently documented and effective processes for the existing two year transfer programs, the Associates of Science and the Bachelor's in Engineering Technology degrees which will be modified to accommodate the new courses associated with a four year BSES program.

Criterion 3. Student Outcomes: The program must have documented student outcomes that prepare graduates to attain the program educational objectives.

Armstrong/SSU response: The current engineering studies programs at both universities prepare students to transfer to ABET accredited programs at the Georgia Institute of Technology and to the relatively new programs at Georgia Southern University (ABET accreditation in process). There is currently documented evidence for the satisfaction of ABET outcomes (a) through (k) for the freshman and sophomore engineering courses taught. We will extend this to accommodate the new courses associated with the four-year BSES program.

Criterion 4. Continuous Improvement: The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which both the program educational objectives and the student outcomes are being attained. The results of these evaluations must be systematically utilized as input for the continuous improvement of the program. Other available information may also be used to assist in the continuous improvement of the program.

Armstrong/SSU response: The current engineering studies programs have to perform the above activities as a necessary component of maintaining SAC's accreditation. We will build on our current processes to accommodate the new courses associated with the four-year BSES program.

Criterion 5. Curriculum: The curriculum requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The faculty must ensure that the program curriculum devotes adequate attention and time to each component, consistent with the outcomes and objectives of the program and institution. The professional component must include:

> (a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline. Basic sciences are defined as biological, chemical, and physical sciences.
> (b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study. The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering practice on the other. Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs.

(c) a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives. Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints. One year is the lesser of 32 semester hours (or equivalent) or one-fourth of the total credits required for graduation.

Armstrong/SSU response: The proposed curriculum satisfies this criterion**.** See curriculum section (page 21)

Criterion 6. Faculty: The faculty must be of sufficient number and must have the competencies to cover all of the curricular areas of the program. There must be sufficient faculty to accommodate adequate levels of student-faculty interaction, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners, as well as employers of students. The program faculty must have appropriate qualifications and must have and demonstrate sufficient authority to ensure the proper guidance of the program and to develop and implement processes for the evaluation, assessment, and continuing improvement of the program, its educational objectives and outcomes. The overall competence of the faculty may be judged by such factors as education, diversity of backgrounds, engineering experience, teaching effectiveness and experience, ability to communicate, enthusiasm for developing more effective programs, level of scholarship, participation in professional societies, and licensure as Professional Engineers.

Armstrong/SSU response: Armstrong's and SSU's engineering programs combined currently have thirteen engineering faculty, two part time instructors and three staff members. The Computer Science Department at Armstrong also has four additional tenured faculty members with doctorates in engineering, who are able to teach engineering courses if necessary.
Currently both programs serve some 400 students combined. Advisement is managed by the office of academic advisement, group advisement sessions as well as individual advisement sessions. Based on the percentages of students in engineering science programs at other universities compared to their total student population (see Table 4), it is expected that the new BSES enrollment numbers will not exceed current numbers. Therefore Armstrong and SSU will have adequate numbers of faculty to accommodate activities required in criterion 6.

Criterion 7. Facilities: Classrooms, offices, laboratories, and associated equipment must be adequate to support attainment of the student outcomes and to provide an atmosphere conducive to learning. Modern tools, equipment, computing resources, and laboratories appropriate to the program must be available, accessible, and systematically maintained and upgraded to enable students to attain the student outcomes and to support program needs. Students must be provided appropriate guidance regarding the use of the tools, equipment, computing resources, and laboratories available to the program. The library services and the computing and information infrastructure must be adequate to support the scholarly and professional activities of the students and faculty.

Armstrong/SSU response: The programs at both institutions currently have labs, classrooms, software and equipment to support the 400+ students enrolled in pre-engineering or engineering technology. All resources are accessible and systematically maintained and upgraded to support program needs. Both programs annually generate additional monies due to course lab fees, which

could potentially cover the cost of new equipment or software needed to expand the program. Both programs do not anticipate that expansion of facilities will be necessary for at least the first three years (conservative). Some mechanical engineering and electrical engineering labs are currently underutilized; the addition of junior and senior classes will maximize use of these labs.

Criterion 8. Institutional Support: Institutional support and leadership must be adequate to ensure the quality and continuity of the program. Resources including institutional services, financial support, and staff (both administrative and technical) provided to the program must be adequate to meet program needs. The resources available to the program must be sufficient to attract, retain, and provide for the continued professional development of a qualified faculty. The resources available to the program must be sufficient to acquire, maintain, and operate infrastructures, facilities, and equipment appropriate for the program, and to provide an environment in which student outcomes can be attained.

Armstrong/SSU response: Armstrong Atlantic State University offers undergraduate and graduate degrees in their College of Liberal Arts, College of Education, College of Health Professions, College of Science and Technology and Graduate Studies. The Armstrong community includes approximately 7,000 students and 290 faculty. Savannah State University offers undergraduate and graduate degrees in their College of Liberal and Social Arts, College of Business Administration, College of Teacher Education, College of Science and Technology and Graduate Studies. The SSU community includes approximately 4,500 students and 220 faculty. Both Armstrong and SSU provide exemplary support and leadership with well established administrative and technical services, student/staff services, faculty professional development, modern facilities and state-of-the-art equipment related to the success of each program. Leadership at **both** institutions fully supports the establishment of the joint BSES program.

Enrollment Projections

Typically, about 20% of each incoming cohort transfer to Georgia Tech; the ones who do not transfer to Georgia Tech switch majors or transfer to other institutions, some of which are not affiliated with the USG. In many cases, capable students whose math or science GPAs are slightly lower than the required 3.0 are not able to transfer to Georgia Tech. The Armstrong/SSU BSES program expects to retain these students who tend to switch majors or transfer to non-USG institutions after not meeting RETP requirements (40+ annually). While Georgia Southern University is an alternative option, many students find a daily travel time of almost 3 hrs incompatible with their family and/or part-time work schedules. An internal survey indicated that some 30-40 students per cohort would prefer to complete a general engineering science program at Armstrong/SSU rather than pursue specialized programs at Georgia Southern University. Thirty-eight percent of the respondents (105) indicated they would be interested in the BSES program. Extrapolating this data to the total number of engineering students enrolled at both institutions (400+), this equates to about 152 students. Note that the program was not marketed in any way prior to the survey. Providing more information to students about the BSES program,

including its benefits, potential job opportunities, graduate school opportunities and internships from local companies would likely improve the numbers of current students who are interested.

Each year, the programs consistently receive inquiries from military and non-traditional candidates (with local jobs in Savannah) who wish to pursue an engineering degree locally. The obligations of students in this category restrict them from attending universities outside of a 30 mile range from their work location or military base. Armstrong and Savannah State are ideally situated to accommodate students in this category.

Both institutions have also invested in faculty, supplies, space, and equipment as the transfer program has grown. Each institution will best realize the returns on this investment if the recently terminated Georgia Tech Savannah transfer program is replaced with a viable program that has the ability to recruit and retain high caliber science and engineering students who will graduate from Armstrong/SSU with workforce-ready skill sets and **stay** in the Savannah region after graduation. With the advent of Georgia Tech Savannah's undergraduate program closing, the numbers of students enrolled in the RETP programs at Savannah State University and Armstrong Atlantic State University has decreased by approximately 30%. This loss has negatively impacted enrollment in Chemistry, Mathematics, Physics, Biology as well as all core courses. The establishment of a BSES program is expected to compensate for this loss in enrollment and simultaneously increase graduation rates at both institutions. The BSES program will improve both Armstrong's and SSU's productivity by graduating high quality students with an accredited four-year degree immediately useful to the work force, locally and nationally.

As the BSES program is supported by several local engineering businesses, as well as the Savannah Chatham County school system, we expect that the advantages of our program will make it an attractive option with local public and private high school graduates. Our recruiters have successfully marketed our current program to students in rural northeast and southwest Georgia. Generally, these students (50+ in number per semester) enter as pre-engineering students since their mathematics and science backgrounds are insufficient for direct entry into the Georgia Tech transfer program. Historically, only 30% of these incoming students are able to maintain their GPA to the RETP standards, we therefore expect that the majority of the remaining students would opt for the joint Armstrong/SSU BSES degree. This was corroborated through an internal survey. Table 6 provides a conservative enrollment projection for the first three years of the program. Projections are based on an internal survey, historical trends regarding unsuccessful RETP applicants and a comparison with similar programs nationally.

Table 6 Enrollment Projections based on internal survey and historical date

	First FY	Second FY	Third FY
I. ENROLLMENT PROJECTIONS			
Student Majors	0	45	79
RETP students who do not meet transfer GPA requirements and are not accepted to Gatech and are unable or unwilling to attend GSU	20	20	20
Transfers from other majors (Engineering Technology, Mathematics)	5	5	5
Military students working on local bases *	5	5	5
New to the institutions	15	20	20
Attrition (Retention Rate = 0.65)	0	-16	-28
Total Majors	45	79	101

*-estimate based on conversation with local military leaders

Enrollment Monitoring

Enrollment will be monitored throughout each semester by the program administrators, with the assistance of the registrars' offices and institutional research offices at both universities. If numbers are below expected, program administrators, in partnership with each university's recruiting office, will redouble efforts to communicate the viability of the program to the local community as well as extend national and international outreach. This may include, but is not limited to, actions such as:

- Reviewing and revising the current recruiting pools and locations.
- Reviewing and revising current marketing techniques in general.
- Developing new marketing techniques. (e.g. New engineering projects/competitions/workshops held on either campus)
- Promoting program on local media.
- Extending outreach to international students.

The list above is by no means exhaustive. Program administrators will consult with recruiting, admissions, the international offices, local industry and the local school board leadership to

review, revise, or create new practices that will sustain and/or improve enrollment and retention as needed.

Reallocation of Funds

Currently, Armstrong's Engineering Studies Program has four full time faculty, two staff members and a part-time faculty member. The current program supports 45 faculty contact hours per semester. We expect to reduce the numbers of sections of lower-level courses so that faculty may teach upper level courses. Though the number of students registered for courses would increase, the number of lower level sections needed would decrease as student numbers would be distributed among upper and lower level courses. This scenario will be true for SSU as well. For example, Table 7 shows the engineering courses to be offered each semester at Armstrong for the new BSES program. This schedule yields a total of 43 contact hours in the Fall and 41 contact hours in the Spring. These hours are appropriate for three faculty at 12 hours per semester and one at 6 hrs per semester. Additionally, Armstrong has four faculty members in the Department of Computer Science (see Table 9) who are also qualified to teach engineering courses. Note that some upper-level engineering courses may have a lab component and that more than one section of an upper-level engineering course may be needed. These estimates indicate that the BSES program will NOT require additional faculty for at least the first three years, besides the conversion of an existing staff line to a faculty line at Armstrong. Note that a jointly appointed program coordinator and a new staff line (lab manager) is requested. It is expected that additional lab fees (due to more students) and lab courses at both institutions would be able to provide funds to support any increase in software and/or equipment needs due to the addition of the new courses.

SSU's Department of Engineering Technology has ten full-time faculty members. The feasibility of SSU faculty teaching upper-level courses parallels Armstrong's, in that fewer sections of lower level courses would be needed with the expansion of the current program. Therefore, SSU faculty who teach lower-level engineering courses will be able to teach upper-level courses as well. However, as SSU would now support two Engineering Technology degrees and an Engineering Science degree, an additional faculty who is available to teach engineering courses is requested.

As the contact hours at both institutions remain largely unchanged, space requirements will remain largely unchanged as well. It is likely that little to no additional monies will be required for the construction of any new space, equipment, or software in order to implement and sustain the BSES degree program for the first three years. Growth rates for engineering programs are quite variable and depend on several factors. These would include: the state of the national and local economy, perceptions of future economical performance, effectiveness of program marketing and recruiting, effectiveness of program retention methods, community support, private/public business support, and the effectiveness of program instruction.

The joint BSES program, therefore, requests the following new lines

- Program Coordinator (jointly appointed)
- One engineering faculty line at SSU
- One engineering faculty line at Armstrong (conversion of an existing staff line)
- One staff line (lab manager) at Armstrong
- One assistant coordinator at SSU (possible modification of existing chair position)
- One assistant coordinator at Armstrong (possible modification of existing coordinator position)

Table 7 Engineering courses offered each semester at Armstrong (refer to Appendix A for course descriptions)

Fall	# sections (est.)	Contact hours
ENGR1170/1170L (3-0-3)	2	12
ENGR1100 (2-1-2)	2	4
ENGR2001(3-0-3)	2	6
ENGR3100 (3-0-3)	2	6
LL Tech elective (3-0-3)	2	6
UL ENGR elective (3-0-3)	3	9
Spring Offerings	#sections	Contact hours
ENGR1371 (3-0-3)	2	6
ENGR 2110 (2-3-3)	2	12
ENGR 3222 (3-0-3)	2	6
LL Tech elective (3-0-3)	2	6
UL ENGR elective (3-0-3)	2	3
*ENGR 4110	2	8

*ENGR4110 will be a new course: senior capstone design

Potential Graduate Degrees or Post graduate programs

The BSES degree allows students to pursue graduate degrees in the various engineering sub-specialties such as electrical, mechanical, etc. (an additional semester of specialized coursework may be required upon admittance), as well as other programs including, but not limited to: engineering management, mathematics/science/technology education, robotics, business (MBA), computational science and engineering, engineering science and mechanics, prosthetics and orthotics, and applied engineering. Many of these Masters or PhD programs are offered by USG institutions. Given their strong analytical background, graduates with a BSES degree will also be well-equipped to pursue postgraduate education in law or medicine.

Faculty

Faculty at both institutions are shown in Table 8, while additional faculty in the Department of Computer Science who are also qualified to teach engineering courses are shown in Table 10.

Table 8 Faculty

Faculty Member Name	**Rank**	**Highest Degree**	**Degrees Earned**	**Academic Department**	**Current Workload**
Andreou, Spyros	Assistant Professor	PhD	BS, MS, PhD	Engineering Technology	12
Awan, Ijaz A.	Associate Professor	MS	BA,MA,MS	Engineering Technology	12
Chukwukere, Sylvester A.	Associate Professor	MS	BS,MS	Engineering Technology	12
Coates, Cameron	Associate Professor	PhD	BS, MS, PhD	Engineering Studies	6 and admin. Duties
Familoni, Babajide	Professor	PhD	B. Sc., PhD	Engineering Technology	12
Goeser, Priya	Associate Professor	PhD	B Tech, PhD	Engineering Studies	12
Jayaraman, Kuppuswamy	Professor	PhD	B.E., M.Sc., PhD	Engineering Technology	12
Johnson, Wayne	Associate Professor	PhD	MS, MS, PhD	Engineering Studies	12
Kalu, Alex	Professor	PhD	BS, MS, PhD	Engineering Technology	12
Lambright, Jonathan	Associate Professor, Int. Dean	PhD	BS, MS, PhD	Engineering Technology	6 hours and Admin. duties
Mustafa, Mohamad A	Associate Professor Int. Chair	PhD	BS, MS,PhD	Engineering Technology	6 hours and admin duties
Murphy, Thomas	Associate Professor	PhD	BS, MS, PhD	Engineering Studies	12
Taylor, Henry, A., Jr.	Associate Professor	MS	BS, MS	Engineering Technology	12
Yousuf, Asad	Associate Professor	EdD	BS, NED, MS, EdD	Engineering Technology	12

Table 9 Additional Faculty at Armstrong with Engineering Degrees qualified to teach courses

Saad, Ashraf	Associate Professor	BS, MS, PhD (Electrical Engr.)	Computer Science	12
Hashemi, Ray	Professor	BS,MS, PhD (Electrical Engr.)	Computer Science	12
Zhang, Hong	Professor	BS, MS, PhD (Electrical Engr.)	Computer Science	6 plus administrative duties
Jung, Hong	Associate Professor	BS,MS, PhD (Electrical Engr.)	Computer Science	12

Appendix A

Courses Descriptions

ENGR 1100 INTRODUCTION TO ENGINEERING 3-0-3
Prerequisite: MATH 1111 or a score of at least 550 on the mathematics portion of the SAT
Orientation to the engineering process from problem formulation to the evolution of creative design. Surveys of the various fields of engineering, professional ethics, problem solving, graphical communication, fundamental concepts of engineering, and the use of software applications for technical reports, computing, and engineering design.

ENGR 1170 ENGINEERING GRAPHICS 2-3-3
Prerequisite: MATH 1113
Introduction to engineering graphics and visualization including sketching, line drawing, simple wireframe and solid modeling. Development and interpretation of drawings and specifications for product realization.

ENGR 1171 COMPUTING IN MATLAB 0-3-1
Prerequisite: CSCI 1301
Introductory computing in MATLAB for students with a solid introductory computing background needing to demonstrate proficiency in the MATLAB language.

ENGR 1371 COMPUTING FOR ENGINEERS 3-0-3
Prerequisite or co-requsite: MATH 1161
Foundations of computing with an introduction to design and analysis of algorithm and an introduction to design and construction of programs for engineering problem-solving.

ENGR 2000 INTRODUCTION TO ENGINEERING MATERIALS 3-0-3
Prerequisite: CHEM 1211 and PHYS 2211K
The structure, property, processing, and performance relationships of engineering materials. Materials selection is treated as part of engineering design.

ENGR 2001 STATICS 3-0-3
Prerequisite: PHYS 2211K
Pre or Corequisite: MATH 2083
Forces and moments; equilibrium in two and three dimensions; multiforce members; friction; trusses; centroids; area moment of inertia; shear and bending moment of beams; and virtual work.

ENGR 2010 COMPUTATIONAL MODELING (COMPUTING TECHNIQUES) 3-0-3
Prerequisites: MATH 2072 and PHYS 2211K and either ENGR 1171 or ENGR 1371 or CSCI 1371
Fundamentals of numerical methods and development of programming techniques for solving engineering problems via computers.

ENGR 2025 INTRODUCTION TO SIGNAL PROCESSING 3-3-4

Prerequisites: MATH 2072 and either ENGR 1171 or ENGR 1371 or CSCI 1301 or CSCI 1371
Introduction to signal processing for discrete-time and continuous-time signals, filtering, frequency response, Fourier transform, Z transform. Laboratory emphasizes computer-based signal processing

ENGR 2030 INTRODUCTION TO COMPUTER ENGINEERING 3-0-3
Prerequisite: CSCI 1060 or CSCI 1301 or ENGR 1371 or CSCI 1371
Computer systems and digital design principles. Architectural concepts, software, Boolean algebra, number systems, combinational datapath elements, sequential logic, storage elements. Design of DRAM control and I/O bus.

ENGR 2031 DIGITAL DESIGN LABORATORY 1-3-2
Prerequisite: ENGR 2030
Design and implementation of digital systems, including a team design project. CAD tools, project design methodologies, logic synthesis, and assembly language programming.

ENGR 2110 CREATIVE DECISIONS AND DESIGN 2-3-3
Prerequisite: ENGR 1170
Prerequisite or co-requisite: ENGR 2001
Fundamental techniques for creating, analyzing, synthesizing, and implementing design solutions to open ended problems with flexibility, adaptability, and creativity through team and individual efforts.

ENGR 2202 DYNAMICS 3-0-3
Prerequisite: ENGR 2001
Kinematics and dynamics of particles and rigid bodies in one, two, and three dimensions. Work-energy and impulse momentum concepts.

ENGR 2990 TOPICS IN ENGINEERING V-V-(1-4)
Prerequisite: announced with the topic
Special topics at freshman and sophomore level of current interest in engineering.

ENGR 3000 CIVIL ENGINEERING SYSTEMS 3-0-3
Prerequisite: MATH 2083
Infrastructure viewed from a systems perspective, analytical approaches and modeling of civil engineered facilities, sustainability, engineering economy applications.

ENGR 3100 CIRCUIT ANALYSIS 3-0-3
Prerequisite: PHYS 2212K
Prerequisite or corequisite: MATH 3411
Basic concepts of DC and AC circuit theory and analysis.

ENGR 3111 ELECTRONICS I 4-0-4
Prerequisite: ENGR 2030 and ENGR 3100
Basic concepts of microelectronic materials, devices, and circuits.

ENGR 3220 MECHANICS OF MATERIALS 3-0-3
Prerequisite: ENGR 2020 or ENGR 2201
Stress and strain, axially loaded members, torsion of circular sections, bending of beams, transformation of stress and strain, thin-walled pressure vessels and column buckling.

ENGR 3230 FLUID MECHANICS 3-0-3
Prerequisite: ENGR 2020 or ENGR 2202
The fundamentals of fluid mechanics. Topics include: fluid statics, control-volume analysis, the Navier-Stokes equations, similitude, viscous, inviscid and turbulent flows, boundary layers.

ENGR 3320 HEAT TRANSFER 3-0-3
Prerequisite: ENGR 3230 and MATH 3411
Introduction to the study of heat transfer, transport coefficients, steady state conduction, transient conduction, radiative heat transfer, and forced and natural convection.

ENGR 3322 FUNDAMENTALS OF THERMODYNAMICS 3-0-3
Prerequisite: CHEM 1211 and MATH 2072 and PHYS 2211K and either CSCI 1301 or ENGR 1371 or CSCI 1371
Introduction to thermodynamics. Thermodynamic properties, energy and mass conservation, entropy and the second law. Second-law analysis of thermodynamic systems, gas cycles, vapor cycles.

ENGR 3700 ENGINEERING ECONOMIC ANALYSIS 2-0-2
Prerequisite: MATH 1161
Fundamental principles of basic techniques of economic analysis of engineering projects including economic measure of effectiveness; time value of money, cost estimation, break-even and replacement analysis.

ENGR 3710 CIRCUITS AND ELECTRONICS 3-0-3
Prerequisite: PHYS 2212K
An introduction to electric circuit elements and electronic devices, and a study of circuits containing such devices. Both analog and digital systems are considered.

ENGR 3770 STATISTICS AND APPLICATIONS 3-0-3
Prerequisite: MATH 2083
Introduction to probability, probability distributions, point estimation, confidence integrals, hypothesis testing, linear regression, and analysis of variance.

ENGR 3960 ENGINEERING INTERNSHIP V-V-(1-4)
Prerequisite: permission of instructor or program coordinator
Practical study experiences in a variety of engineering environments under the direction of faculty and appropriate off-campus supervisors.

ENGR 4990 TOPICS IN ENGINEERING V-V-(1-4)
Prerequisites: announced with the topic
Special topics at junior and senior level of current interest in engineering.

ENGR 4999 INDEPENDENT STUDY V-V-(1-4)
Prerequisites: permission of the instructor

PHYS 3312 ELECTROMAGNETISM 3-0-3
Prerequisite: PHYS 2212K (minimum grade of of C) and MATH 2083 (minimum grade of C)
Electrostatics, magnetostatics, electromagnetism, electromagnetic waves, and applications, using both the integral form and differential form of Maxwell's equations.

PHYS 4120 SCIENTIFIC MEASUREMENT WITH DIGITAL INTERFACING 1-5-3
Prerequisite: PHYS 3120 (minimum grade of C) and CSCI 1301 (minimum grade of C)
Principles and techniques used in measuring physical quantities, including transducers, data acquisition interfaces, and data analysis. Data acquisition and process control capabilities of the computer as a general purpose lab instrument. Hands-on lab experience through applications in experimental physics. Includes a variety of oral and written assignments. Physics faculty involved in assessments.

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