



## Program Planning Guide

### Biotechnology - Bioprocess Manufacturing Technology, Associate in Applied Science (A20100)

**Program Length:** 5 semesters

**Program Sites:** Lee Main Campus; Distance Education - some courses may be available online or hybrid

**Career Pathway Options:** Associate in Applied Science Degree in Biotechnology - Bioprocess Manufacturing Technology

Suggested Course Schedule		Class	Lab	Work	Credits	Notes:
<b>1st Semester (fall)</b>						
ACA 122	College Transfer Success	0	2	0	1	
BPM 110	Bioprocess Practices	3	4	0	5	BIOWORK
BIO 110	Principles of Biology	3	3	0	4	
PTC 110	Industrial Environment	3	0	0	3	BIOWORK
ENG 111	Writing & Inquiry	3	0	0	3	
	<b>Total Semester Hours</b>	12	9	0	16	
<b>2nd Semester (spring)</b>						
BIO 175	General Microbiology	2	2	0	3	
BPM 111	Bioprocess Measurements	3	3	0	4	
CIS 110	Introduction to Computers	2	2	0	3	
Mathematics requirement, select one:						
MAT 121	Algebra/Trigonometry I	2	2	0	3	
MAT 171	Precalculus Algebra	3	2	0	4	
	<b>Total Semester Hours</b>	9/10	9	0	13/14	
<b>3rd Semester (summer)</b>						
ISC 121	Environmental Health & Safety	3	0	0	3	
ISC 175	Quality Fundamentals	1	0	0	1	
ENG 112	Writing/Research in the Disc	3	0	0	3	
	<b>Total Semester Hours</b>	7	0	0	7	



<b>4th Semester (fall)</b>						
CHM 131	Introduction to Chemistry	3	0	0	3	
CHM 131A	Introduction to Chemistry Lab	0	3	0	1	
BPM 112	Upstream Bioprocessing	3	4	0	5	
ISC 278	cGMP Quality Systems	2	0	0	2	
PTE 116	Pathway to Employ. Bio/Chem	2	3	0	3	
Communications Elective		3	0	0	3	COM 231 recommended
<b>Total Semester Hours</b>		13	10	0	17	
<b>5th Semester (spring)</b>						
BPM 113	Downstream Bioprocessing	3	3	0	4	
PTC 228	Pharmaceutical Issues	1	0	0	1	
ISC 280	Validation Fundamentals	1	2	0	2	
WBL 111	Work-Based Learning	0	0	10	1	
Humanities/Fine Arts Elective		3	0	0	3	
Social/Behavioral Science Elective		3	0	0	3	ECO 251 or PSY 150 recommended
<b>Total Semester Hours</b>		11	5	10	14	
<b>Total Semester Hours Required for Graduation: 67</b>						



## Course Descriptions

### **ACA 122 College Transfer Success**

This course provides information and strategies necessary to develop clear academic and professional goals beyond the community college experience. Topics include the CAA, college policies and culture, career exploration, gathering information on senior institutions, strategic planning, critical thinking, and communications skills for a successful academic transition. Upon completion, students should be able to develop an academic plan to transition successfully to senior institutions. This course has been approved for transfer under the CAA and ICAA as a premajor and/or elective course requirement.

### **BIO 110 Principles of Biology**

*Corequisite: DRE 098 or appropriate placement test scores*

This course provides a survey of fundamental biological principles for non-science majors. Emphasis is placed on basic chemistry, cell biology, metabolism, genetics, evolution, ecology, diversity, and other related topics. Upon completion, students should be able to demonstrate increased knowledge and better understanding of biology as it applies to everyday life. This course has been approved for transfer under the CAA and ICAA as a universal general education transfer component (UGETC) course in Natural Sciences.

### **BIO 175 General Microbiology**

*Prerequisites Take one: BIO 110, BIO 111, BIO 163, BIO 165, or BIO 168*

This course covers principles of microbiology with emphasis on microorganisms and human disease. Topics include an overview of microbiology and aspects of medical microbiology, identification and control of pathogens, disease transmission, host resistance, and immunity. Upon completion, students should be able to demonstrate knowledge of microorganisms and the disease process as well as aseptic and sterile techniques. This course has been approved for transfer under the CAA and ICAA as a premajor and/or elective course requirement.

### **BPM 110 Bioprocess Practices**

This course provides a study of plant operations including various plant utility systems and detailed study of the varied plant environments in a bioprocessing facility. Emphasis is placed on quality mindset and principles of validation through applications of monitoring procedures. Upon completion, students should be able to demonstrate the rigors of industry regulation and its necessity.

### **BPM 111 Bioprocess Measurements**

*Prerequisites: Take BPM 110*

This course covers a variety of physical measurements. Emphasis is placed on pH, temperature, pressure and flow rates, as well as spectrophotometry, and biochemical and chemical analysis methods. Upon completion, students should be able to demonstrate and perform many aspects of process monitoring.

### **BPM 112 Upstream Processing**

*Prerequisite: Take BPM 111*

This course introduces techniques involved in cell growth and fractionation. Topics include fermentation theory and application, as well as cell harvesting, cell disruption and fractionation methods. Upon completion, students should be able to grow cells, as well as isolate and collect various fractions.

### **BPM 113 Downstream Bioprocessing**

*Prerequisites: Take BPM 111*

This course introduces a variety of techniques involved in separation procedures. Topics include extraction and precipitation, concentration and molecular filtration methods, as well as different types of chromatography. Upon completion, students should be able to perform separation procedures with an understanding of industrial scale procedures

### **CHM 131 Introduction to Chemistry**

This course introduces the fundamental concepts of inorganic chemistry. Topics include measurement, matter and energy, atomic and molecular structure, nuclear chemistry, stoichiometry, chemical formulas and reactions, chemical bonding, gas laws, solutions, and acids and bases. Upon completion, students should be able to demonstrate a basic understanding of chemistry as it applies to other fields. This course has been approved for transfer under the CAA and ICAA as a general education course in Natural Science.

**CHM 131A Introduction to Chemistry Lab**

*Corequisite: CHM 131*

This course is a laboratory to accompany CHM 131. Emphasis is placed on laboratory experiences that enhance materials presented in CHM 131. Upon completion, students should be able to utilize basic laboratory procedures and apply them to chemical principles presented in CHM 131. This course has been approved for transfer under the CAA and ICAA as a general education course in Natural Science.

**CIS 110 Introduction to Computers**

This course introduces computer concepts, including fundamental functions and operations of the computer. Topics include identification of hardware components, basic computer operations, security issues, and use of software applications. Upon completion, students should be able to demonstrate an understanding of the role and function of computers and use the computer to solve problems. This course has been approved for transfer under the CAA and ICAA as a general education course in Mathematics.

**COM 231 Public Speaking**

This course provides instruction and experience in preparation and delivery of speeches within a public setting and group discussion. Emphasis is placed on research, preparation, delivery, and evaluation of informative, persuasive, and special occasion public speaking. Upon completion, students should be able to prepare and deliver well-organized speeches and participate in group discussion with appropriate audiovisual support. This course has been approved for transfer under the CAA and ICAA as a universal general education transfer component (UGETC) course in Humanities/Fines Arts.

**ECO 251 Principles of Microeconomics**

This course introduces economic analysis of individual, business, and industry in the market economy. Topics include the price mechanism, supply and demand, optimizing economic behavior, costs and revenue, market structures, factor markets, income distribution, market failure, and government intervention. Upon completion, students should be able to identify and evaluate consumer and business alternatives in order to efficiently achieve economic objectives. This course has been approved for transfer under the CAA and ICAA as a universal general education transfer component (UGETC) course in Social/Behavioral Sciences.

**ENG 111 Writing and Inquiry**

*Prerequisites: DRE 098 or ENG 002*

*Local Prerequisites: Take one: 1) ENG 011; 2) ENG 002; 3) DRE 098; 4) ENG 090; 5) ENG 095*

This course is designed to develop the ability to produce clear writing in a variety of genres and formats using a recursive process. Emphasis includes inquiry, analysis, effective use of rhetorical strategies, thesis development, audience awareness, and revision. Upon completion, students should be able to produce unified, coherent, well-developed essays using standard written English. This course has been approved for transfer under the CAA and ICAA as a universal general education transfer component (UGETC) course in English Composition.

**ENG 112 Writing/Research in the Disc**

*Prerequisite: ENG 111*

This course, the second in a series of two, introduces research techniques, documentation styles, and writing strategies. Emphasis is placed on analyzing information and ideas and incorporating research findings into documented writing and research projects. Upon completion, students should be able to evaluate and synthesize information from primary and secondary sources using documentation appropriate to various disciplines. This course has been approved for transfer under the CAA and ICAA as a universal general education transfer component (UGETC) course in English Composition.

**ISC 121 Environmental Health and Safety**

This course covers workplace environmental, health, and safety concepts. Emphasis is placed on managing the implementation and enforcement of environmental health and safety regulations and on preventing accidents, injuries, and illnesses. Upon completion, students should be able to demonstrate an understanding of basic concepts of environmental, health, and safety.

**ISC 175 QA Fundamentals**

This course is designed to increase fundamental knowledge in the philosophies, principles, and practice of quality in the work environment. Topics include the history and basics of quality, philosophies of quality, daily application of principles, and roles of quality professions, with emphasis on cGMP environment. Upon completion, students should be able to discuss quality fundamentals, components of quality systems, and identify standards and programs of quality.

**ISC 278 cGMP Quality Systems**

This course focuses on the development, implementation, and on-going maintenance of a quality system in a cGMP environment. Topics include the cGMP standard, components of cGMP quality systems, quality function rules and training, and development of documentation such as SOPs and system review procedures. Upon completion, the student should be able to identify the components of a quality system and develop a quality system manual utilizing the cGMP standard.

**ISC 280 Validation Fundamentals**

This course covers the fundamental concepts of components of a validation program in a cGMP environment. Emphasis is placed on FDA requirements concerning validation, types of validation, documentation, procedures, and the QA role. Upon completion, students should be able to discuss the purpose of validation, identify the steps in the validation process, and effectively utilize sample documentation.

**MAT 121 Algebra/Trigonometry**

*Prerequisite: Take one set:*

*Set 1: DMA 010, DMA 020, DMA 030, DMA 040, DMA 050, and DMA 060; Set 2: DMA 025, DMA 040, DMA 050, DMA 060; Set 3: DMA 025, DMA 045, DMA 060; Set 4: DMA 010, DMA 020, DMA 030, DMA 045, DMA 060; Set 5: MAT 003;*

*Local RISE corequisites: Take one group:*

- 1) MAT-021; 2) MAT-003; 3) DMA-010, DMA-020, DMA-030, DMA-040, DMA-050, DMA-060; 4) MAT-121; 5) MAT-161
- 7). DMA-010, DMA-020, DMA-030, DMA-040, DMA-050, DMA-065; 7. DMA-010, DMA-020, DMA-030, DMA-045, DMA-065;
- 8) DMA-025, DMA-045, DMA-060, DMA-070, DMA-080;
- 9) DMA-025, DMA-040, DMA-050, DMA-065; 10) MAT-060, MAT-070; 11) MAT-060, MAT-080; 12) MAT-060, MAT-090;
13. MAT-095

This course provides an integrated approach to technology and the skills required to manipulate, display, and interpret mathematical functions and formulas used in problem solving. Topics include the properties of plane and solid geometry, area and volume, and basic proportion applications; simplification, evaluation, and solving of algebraic equations and inequalities and radical functions; complex numbers; right triangle trigonometry; and systems of equations. Upon completion, students will be able to demonstrate the ability to use mathematics and technology for problem-solving, analyzing and communicating results.

**MAT 171 Precalculus Algebra**

*Prerequisite: Take one set:*

1. DMA-010, DMA-020, DMA-030, DMA-040, DMA-050, DMA-060, DMA-070, and DMA-080; 2. DMA-010, DMA-020, DMA-030, DMA-040, DMA-050, and DMA-065; 3. DMA-010, DMA-020, DMA-030, DMA-045, DMA-060, DMA-070, and DMA-080
4. DMA-010, DMA-020, DMA-030, DMA\_045, & DMA-065;
5. DMA-025, DMA-040, DMA-050, DMA-060, DMA-070, & DMA-080; 6. DMA-025, DMA-040, DMA-050, & DMA-065;
7. DMA-025, DMA-045, DMA-060, DMA-070, & DMA-080;
8. DMA-025, DMA-045, & DMA-065; 9. MAT-212; 10. MAT-003

*Local RISE Corequisites: Take one group: 1. MAT-071; 2. MAT-003; 3. DMA-010, DMA-020, DMA-030, DMA-040, DMA-050, DMA-060, DMA-070, DMA-080; 4. MAT-121; 5. MAT-161;*

6. DMA-010, DMA-020, DMA-030, DMA-040, DMA-050, DMA-065; 7. DMA-010, DMA-020, DMA-030, DMA-045, DMA-065;
8. DMA-025, DMA-045, DMA-065; 9. DMA-025, DMA-040, DMA-050, DMA-060, DMA-070, DMA-080; 10. DMA-025, DMA-045, DMA-060, DMA-070, DMA-080; 11. DMA-010, DMA-020, DMA-030, DMA-045, DMA-060, DMA-070, DMA-080; 12. DMA-025, DMA-040, DMA-050, DMA-065; 13. MAT-060, MAT-080;
14. MAT-060, MAT-090; 15. MAT-095

This course is designed to develop topics which are fundamental to the study of Calculus. Emphasis is placed on solving equations and inequalities, solving systems of equations and inequalities, and analysis of functions (absolute value, radical, polynomial, rational, exponential, and logarithmic) in multiple representations. Upon completion, students should be able to select and use appropriate models and techniques for finding solutions to algebra-related problems with and without technology. This course has been approved for transfer under the CAA and ICAA as a universal general education transfer component (UGETC) course in Mathematics.

**PSY 150 General Psychology**

This course provides an overview of the scientific study of human behavior. Topics include history, methodology, biopsychology, sensation, perception, learning, motivation, cognition, abnormal behavior, personality theory, social psychology, and other relevant topics. Upon completion, students should be able to demonstrate a basic knowledge of the science of psychology. This course has been approved for transfer under the CAA and ICAA as a universal general education transfer component (UGETC) course in Social/Behavioral Sciences.

**PTC 110 Industrial Environment**

This course introduces the pharmaceutical industry, including a broad overview of work in this field. Emphasis is placed on good manufacturing practices (GMP), work conduct, company organization, job expectations, personal safety, hygiene, and company rules and regulations. Upon completion, students should be able to follow good manufacturing practice regulations and inspect a pharmaceutical manufacturing facility for compliance with GMP.

**PTC 228 Pharmaceutical Issues**

This course provides a forum for discussion of current pharmaceutical topics. Emphasis is placed on events, news, regulations, and technology in pharmaceutical manufacturing. Upon completion, students should be able to demonstrate an understanding of the dynamic nature of the pharmaceutical industry.

**PTE 116 Pathway to Employment-Biological/Chemical**

This course introduces fundamental employment core skillsets required to effectively enter the biological and chemical workforce and/or a registered apprenticeship and may also serve as a component of a pre-apprenticeship. Topics include workplace safety, communication skills, industry overview, tools and equipment, computation and financial literacy, materials, employability skills, personal health, career exploration and pathways including apprenticeship, job preparation and required job skills, and site visits. Upon completion, students should be able to explain how to locate and engage employers, present themselves in a professional manner, perform basic on-the-job skills, pursue necessary job-specific training and/or certification, and enter a biological and chemical career with the knowledge required to be successfully employed.

**WBL 111 Work-Based Learning I**

*Local Prerequisite: Approval of Instructor or Dpt. Chair*

This course provides a work-based learning experience with a college-approved employer in an area related to the student's program of study. Emphasis is placed on integrating classroom learning with related work experience. Upon completion, students should be able to evaluate career selection, demonstrate employability skills, and satisfactorily perform work-related competencies.


**Approved Humanities/Fine Arts Electives**  
**Associate in Applied Science Degree/Diploma**

ART 111	Art Appreciation
ART 114	Art History Survey I
ART 115	Art History Survey II
DRA 111	Theatre Appreciation
ENG 125	Creative Writing I
ENG 231	American Literature I
ENG 232	American Literature II
ENG 241	British Literature I
ENG 242	British Literature II
HUM 110	Technology & Society
HUM 115	Critical Thinking
HUM 120	Cultural Studies
HUM 122	Southern Culture
HUM 150	American Women's Studies
HUM 160	Introduction to Film
MUS 110	Music Appreciation
MUS 112	Introduction to Jazz
PHI 240	Introduction to Ethics
REL 110	World Religions
REL 211	Intro to Old Testament
REL 212	Intro to New Testament

**Approved Social/Behavioral Science Electives**  
**Associate in Applied Science Degree/Diploma**

ANT 210	General Anthropology
ANT 220	Cultural Anthropology
ECO 151	Survey of Economics
ECO 251	Principles of Microeconomics
ECO 252	Principles of Macroeconomics
GEL 111	World Regional Geography
HIS 111	World Civilization I
HIS 112	World Civilization II
HIS 131	American History I
HIS 132	American History II
HIS 222	African-American History I
HIS 223	African-American History II
HIS 226	The Civil War
HIS 236	North Carolina History
POL 120	American Government
PSY 150	General Psychology
PSY 237	Social Psychology
PSY 241	Developmental Psychology
PSY 246	Adolescent Psychology
PSY 281	Abnormal Psychology
SOC 210	Introduction to Sociology
SOC 213	Sociology of the Family
SOC 220	Social Problems
SOC 225	Social Diversity
SOC 232	Social Context of Aging
SOC 240	Social Psychology