



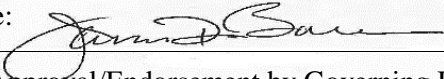
Cover Sheet for In-State Institutions New Program or Substantial Modification to Existing Program

Institution Submitting Proposal	Carroll Community College
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Each action below requires a separate proposal and cover sheet.

- | | |
|---|---|
| <input checked="" type="radio"/> New Academic Program | <input type="radio"/> Substantial Change to a Degree Program |
| <input type="radio"/> New Area of Concentration | <input type="radio"/> Substantial Change to an Area of Concentration |
| <input type="radio"/> New Degree Level Approval | <input type="radio"/> Substantial Change to a Certificate Program |
| <input type="radio"/> New Stand-Alone Certificate | <input type="radio"/> Cooperative Degree Program |
| <input type="radio"/> Off Campus Program | <input type="radio"/> Offer Program at Regional Higher Education Center |

Payment Submitted: <input checked="" type="radio"/> Yes <input type="radio"/> No	Payment Type: <input type="radio"/> R*STARS <input type="radio"/> Check	Date Submitted: December 10, 2018
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Department Proposing Program	Mathematics and Engineering		
Degree Level and Degree Type	Associate of Science (A.S.)		
Title of Proposed Program	Engineering (with Concentrations in Mechanical/Civil and Chemical/Biomedical)		
Total Number of Credits	60		
Suggested Codes	HEGIS: 0901	CIP: 14.0101	
Program Modality	<input checked="" type="radio"/> On-campus	<input type="radio"/> Distance Education (fully online)	<input type="radio"/> Both
Program Resources	<input checked="" type="radio"/> Using Existing Resources	<input type="radio"/> Requiring New Resources	
Projected Implementation Date	<input checked="" type="radio"/> Fall	<input type="radio"/> Spring	<input type="radio"/> Summer Year: 2019
Provide Link to Most Recent Academic Catalog	https://www.carrollcc.edu/uploadedFiles/CarrollCCedu/Content/PDF/Credit_Publications/Catalog/2018-2019%20Catalog%20for%20Web.pdf		
Preferred Contact for this Proposal	Name: Melody L. Moore		
	Title: Associate Vice President for Program Development and Partnerships		
	Phone: (410) 386-8412		
	Email: memoore@carrollcc.edu		
President/Chief Executive	Type Name: James Ball		
	Signature: 	Date: 12/10/2018	
	Date of Approval/Endorsement by Governing Board:		11/14/2018

Revised 6/13/18

MARYLAND HIGHER EDUCATION COMMISSION

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Engineering A.S. Carroll Community College

A. Centrality to institutional mission statement and planning priorities:

1. Provide a description of the program, including the degree to be awarded, each area of specialization/concentration (if applicable), purpose or objective, and how it relates to the institution's approved mission.

Carroll Community College (CCC) is a public, open admission, associate-degree-granting college serving Carroll County, MD with baccalaureate preparation programs, career education, workforce and business development, and personal and cultural enrichment opportunities. As a vibrant, learner-centered community, the college engages students as active learners, prepares them for an increasingly diverse and changing world, and encourages their lifelong learning.

The College mission is to provide “accessible, high-quality educational opportunities to advance careers, enrich lives, and strengthen the community” it serves. This mission is conveyed through seven college goals, two of which are expressly addressed by the proposed *Associate of Science (A.S.) degree program in Engineering with Concentrations in Mechanical/Civil and Chemical/Biomedical*. Those two are:

Goal 1: Provide associate degree programs, career, and credentialing preparation, job skill enhancement, continuing professional education, and career resources and support to strengthen the regional workforce.

Goal 2: Support student attainment of essential skills in general education and prepare students for transfer to earn degrees beyond the associate.

The Associate of Science in Engineering degree program (with concentrations in mechanical/civil and chemical/biomedical) is intended for students who ultimately wish to transfer to a four-year engineering degree program. However, there are many different routes that engineering students can take after finishing their associate's degree. Whether they want to enter the workforce right away or continue into higher education, they will be well-equipped with foundational knowledge to help them succeed.

Through engaging lab, field, and classroom activities, the college strives to provide engineering students with the current knowledge and skills necessary to prepare them for their educational and career goals. The courses in the program will expose engineering students to the fundamentals of the subject on a general level, and give them the opportunity to specialize in mechanical/civil or chemical/biomedical. They will come to understand analysis, design, and troubleshooting, using a variety of instructional modes such as technology, investigation, and interpretation of data, oral and written communication, information literacy, problem-solving, and critical thinking skills.

2. Explain how the proposed program supports the institution's strategic goals and provide evidence that affirms it is an institutional priority.

The A.S. degree in Engineering with concentrations in mechanical/civil and chemical/biomedical directly supports two of the college's strategic goals in its *FY2019 Strategic Initiatives*.

Goal II: Enrollment Development – Respond to community and student needs through resourcefulness in instructional programming, course delivery and scheduling, student services, and effective communications.

The new A.S. in Engineering degree with concentrations in mechanical/civil and chemical/biomedical is expected to generate new enrollment for the college. CCC is currently developing ways to expand enrollment through new scheduling options such as more evening courses, online courses, and hybrid courses and is also considering full-time programs all day on Fridays and a Weekend College program. Services, processes, and procedures are being revised to ensure that non-traditional students feel welcome and not encumbered by paperwork.

Goal III: Economic and Community Development – Support Carroll County business, workforce, and community development through career programs, customized training, and strategic alliances.

This program is being developed in response to the local and regional workforce needs. The main underlying mission of community colleges is to serve their communities. The college makes it a priority to meet local workforce needs by the development of long-term relationships with industry partners. Success comes from taking great care to listen to the needs of industry partners on multiple levels—individual students, businesses, the economy—locally, regionally, and nationally. It is through these connections that it was determined that the College needed to develop an A.S. degree program in Engineering with concentrations in mechanical/civil and chemical/biomedical to supply the area workforce.

3. Provide a brief narrative of how the proposed program will be adequately funded for at least the first five years of program implementation. (Additional related information is noted in section L).

Two other Engineering programs exist at the College, an A.S.E. in Computer Engineering and an A.S.E. in Electrical Engineering. Because of these programs, an engineering laboratory was developed several years ago. This new program, an A.S. in Engineering with concentrations in mechanical/civil and chemical/biomedical, will also use that facility. Therefore no additional funds are needed beyond what is already budgeted, and it is anticipated that no additional funding will be needed until year four (2022-2023) when an additional faculty member will be hired.

4. Provide a description of the institution's commitment to:
 - a. ongoing administrative, financial, and technical support of the proposed program
 - b. continuation of the program for a period of time sufficient to allow enrolled students to complete the program

The program will be housed in the Mathematics and Engineering Division and, as stated above, two other Engineering programs already exist at the College, an A.S.E. in Computer Engineering and an A.S.E. in Electrical Engineering. Through the Division, administrative and financial support for the Engineering programs already is and will continue to be provided. Technical support will be provided by the College's Network and Technology Services Department.

If in the future, a decision is made to discontinue the A.S. in Engineering degree program and/or one of its concentrations, a teach-out plan will be developed and executed to ensure that all students in the program will have the opportunity to obtain all courses needed to complete the program.

B. Critical and compelling regional or statewide need as identified in the State Plan:

1. Demonstrate demand and need for the program in terms of meeting present and future needs of the region and the State in general based on one or more of the following:
 - a. the need for the advancement and evolution of knowledge
 - b. societal needs, including expanding educational opportunities and choices for minority and educationally disadvantaged students at institutions of higher education
 - c. the need to strengthen and expand the capacity of historically black institutions to provide high quality and unique educational programs

According to the U.S. Bureau of Labor Statistics (BLS), the field of engineering is expected to grow by 7 percent nationally in the coming decade. In recent years, the prospects for college graduates in all fields have been fair at best, but engineering graduates experience a much more favorable job market. Experts say demand for engineers will continue to grow as governments and industry work to meet the challenges of a growing global population and dwindling resources.¹

Maryland has a very solid economy that is constantly growing and changing. With political and military connections to the nation's capital, engineering degree programs and firms are found across the state. Private and public research facilities, civil corporations, and commercial companies all provide Maryland residents engineering jobs. According to the U.S. Bureau of Labor Statistics, there are 60,200 engineers, including architects which are included in the BLS calculation, across Maryland.²

The largest engineering sector in terms of employment in Maryland is civil engineering, with 7,110 workers employed in the state. Other popular engineering sectors in Maryland include mechanical engineering, with 5,540 workers, chemical engineering, with 900 workers, biomedical engineering, with 710 workers, civil engineering technicians, with 1250 workers, and mechanical engineering technicians, with 670 workers.³

Engineering is the discipline, art, and profession of acquiring and applying technical, scientific, and mathematical knowledge to design and implement materials, structures, machines, devices, systems, and processes that safely realize a desired objective or invention. Engineers solve problematic technical issues by using the fundamentals of math and science to develop cost-effective solutions. Engineers not only work in the development and design of new products, but they also work in the testing, production, and maintenance of new products. Engineers oversee production assembly lines, determine why products break down, and administer tests to improve product quality. They also determine how much money and time is necessary to finish a project.

The annual average salary of engineers, calculated in May 2011 by the BLS equaled \$85,850. The bottom tenth percentile of engineers in Maryland earned an average salary of \$44,950, while the top tenth percentile of engineers in Maryland earned an average salary of \$136,770. The current average

¹ Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, OOH FAQs, on the Internet at <https://www.bls.gov/ooh/architecture-and-engineering/home.htm> (visited October 10, 2018).

² Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, OOH FAQs, on the Internet at https://www.bls.gov/oes/current/oes_md.htm (visited October 10, 2018).

³ Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Employment Statistics*, on the internet at https://www.bls.gov/oes/current/oes_md.htm (visited October 10, 2018).

salaries for engineers of all kinds are going to increase as the demand for their skills increases, allowing anyone to find a very stable job in a very stable economy.

As a community college, Carroll subscribes to the “open door” admissions standard. Open admissions refer to colleges offering admittance to all students as long as they have completed high school or passed the GED. It is meant to provide access and remove barriers to higher education, particularly for disadvantaged or underprivileged backgrounds. The result is that many students enroll who are not prepared to take on college-level work. For those students who choose programs such as the proposed Engineering A.S. program with concentrations in mechanical/civil and chemical/biomedical, which require high levels of mathematics and science knowledge, the barriers can seem insurmountable.

In response, CCC offers remedial classes, academic assistance, and support services to help them succeed. The faculty, staff, and administrators are committed to creating a student-centered campus where chances of success are equitable for every student, where every student feels valued, and where students achieve their goals.

2. Provide evidence that the perceived need is consistent with the 2017-2021 Maryland State Plan for Postsecondary Education.
 - a. Statewide Plan Goal #1: Student Access
 - b. Statewide Plan Goal #2: Student Success
 - c. Statewide Plan Goal #3: Innovation in Higher Education

The proposed program is well aligned with the 2017-2021 Maryland State Plan for Postsecondary Education. The Associate of Science in Engineering with concentrations in mechanical/civil and chemical/biomedical is intended to prepare highly trained students for transfer and work in organizations where they can contribute to the needs of society. The long-term success of CCC’s prior and current engineering programs attests to the quality and effectiveness of these programs.

Through robust online course offerings, students can undertake course-related activities at a time and location most convenient to them, allowing students to participate in and to complete their program even if their work schedules do not permit regular class attendance, thus supporting Goal 1, “Access: Ensure equitable access to affordable and quality postsecondary education for all Maryland residents.”

Similarly, the proposed program is consistent with Goal 3, “Innovation: Foster innovation in all aspects of Maryland higher education to improve access and student success,” which articulates Maryland’s aspiration to be “a national leader in the exploration, development, and implementation of creative and diverse education and training opportunities that will align with state goals, increase student engagement, and improve learning outcomes...” By leveraging technology in innovative ways to make CCC offerings more accessible and interactive, candidates can pursue “anytime, anywhere” learning opportunities.

The proposed program is also consistent with Goal 2, “Success: Completion of a credential such as a licensure or certification, sub-degree certificate, or degree.” Due to dedicated advisors, milestone advising, retention alert software, an initiative that reaches out to non-completers to get them back in school and to completion, and the collaboration between faculty and the student services staff, Carroll Community College has one of the highest completion rates nationally.

Data from the Student Tracker Postsecondary Completions Institutional Benchmark Reports, prepared and distributed by the National Student Clearinghouse Research Center, regarding the percent of first-time, degree-seeking fall cohorts completing degree or certificate programs within six years of entry, indicates that of the 2010 cohort, Carroll had a 54.7% completion rate for all students compared to the national rate of 39.3%. For just full-time students, or the same cohort, CCC's rate was 77.3% compared to 54.5% nationally.

C. Quantifiable & reliable evidence and documentation of market supply & demand in the region and State:

1. Describe potential industry or industries, employment opportunities, and expected level of entry (*ex. mid-level management*) for graduates of the proposed program.

The broad discipline of engineering encompasses a range of sub-disciplines, including Aerospace Engineering, Biomedical Engineering, Civil Engineering, Chemical Engineering, Electrical Engineering, and Mechanical Engineering.

For entry-level engineering jobs, individuals typically must have a bachelor's degree in an engineering discipline that's related to the type of work they plan to do. However, some engineering technicians only need an associate's degree. Additional education or licensure, or both, may be needed for advancing in the occupation. Getting practical experience while in college, such as by completing an internship or participation in a cooperative engineering program, also is recommended.⁴

2. Present data and analysis projecting market demand and the availability of openings in a job market to be served by the new program.

The engineering industry in Maryland is one of many that continue to thrive and project growth in the next decade or two. Sweeping advances in science, industry, and computing have sparked a revolution in engineer employment. The U.S. Bureau of Labor Statistics forecasts rapid growth for a range of engineering occupations through 2026.⁵

3. Discuss and provide evidence of market surveys that clearly provide quantifiable and reliable data on the educational and training needs and the anticipated number of vacancies expected over the next 5 years.

The Maryland Department of Labor, Licensing & Regulation, *Maryland Occupational Projections – 2016-2026 Workforce Information and Performance* forecasts the employment of engineers and engineering technicians in Maryland in 2016 and the long-term employment projections for the 2016-2026 period. The required level of education needed is also included in this table.⁶

⁴ Bureau of Labor Statistics, U.S. Department of Labor, *Career Outlook*, on the Internet at <https://www.bls.gov/careeroutlook/2018/article/engineers.htm> (visited October 10, 2018).

⁵ Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, OOH FAQs, on the Internet at https://www.bls.gov/oes/current/oes_md.htm (visited October 10, 2018).

⁶ Maryland Department of Labor, Licensing & Regulation, *Maryland Occupational Projections – 2016-2026 Workforce Information and Performance* on the Internet at <https://www.dlrr.state.md.us/lmi/iandoproj/maryland.shtml> (visited October 10, 2018).

Maryland Occupational Projections 2016-2026									
Occ Code	Occupational Title	Employment				Separations		Total	Education Value
		2016	2026	Change	Pct. Chg	Exits	Transfers		
17-2000	Engineers	41,969	44,063	2,094	5.00%	9,374	17,740	29,208	Bachelor degree
17-3000	Drafters, Engineering Technicians, and Mapping Technicians	12,655	13,334	679	5.40%	4,027	6,912	11,618	Associate degree

4. Data showing the current and projected supply of prospective graduates.

The job outlook for engineers and engineering technicians is shaped both by society's growing need to devise solutions to technically challenging problems - global warming, a shortage of clean water, the demand for faster and smarter computing - and by short supply. Only 4.5 percent of all undergraduates come out of school with engineering degrees, according to the National Science Foundation. This number is not enough to meet the future need for engineers.⁷

D. Reasonableness of program duplication (search by CIP or HEGIS codes or check other institution's websites):

1. Identify similar programs in the State and/or same geographical area. Discuss similarities and differences between the proposed program and others in the same degree to be awarded.

A search of the Maryland Higher Education Commission program inventory database for CIP Code 14.0101 – Engineering, General indicates that there are ten general engineering associate degree programs in the State such as what CCC is developing. Because of the rigor of engineering programs, the number of completers/graduates is often low. Having the program at eight community colleges in the state will not over-saturate the field.

Institution	Program Title	Award	Taxonomy
Anne Arundel Community College	Engineering Transfer	Associate Degree	494001
Baltimore City Community College	Engineering Transfer	Associate Degree	494001
Cecil College	Engineering Civil Engineering Mechanical Engineering	Associate Degree	494001
College of Southern Maryland	Engineering Transfer	Associate Degree	494001
Community College of Baltimore County	Engineering Transfer Certificate	Lower Division Certificate	494001

⁷ You're an Engineer: You're Hired. *U.S. News & World Report*, March 2012.

Community College of Baltimore County	Engineering	Associate Degree	494001
Hagerstown Community College	Mechanical Engineering	Associate Degree	494001
Harford Community College	Engineering Transfer	Associate Degree	494001
Howard Community College	Engineering Transfer	Associate Degree	494001
Montgomery College	Engineering Science	Associate Degree	494001
Prince George's Community College	Engineering	Associate Degree	494001
Washington Adventist University	Engineering	Associate Degree	464001

At the state university level, Frostburg State University, Johns Hopkins University, Loyola University, University of Maryland – Baltimore County, and University of Maryland – Eastern Shore all offer bachelor's programs in engineering and provide many opportunities for transfer.

2. Provide justification for the proposed program.

Maryland is one of the smallest states geographically, but it is one of the wealthiest states in the country. Recently, Maryland has seen growth in Energy and Sustainability, Health and Life Sciences, Manufacturing and Production and general manufacturing fields.⁸ Each of those sectors requires talented engineering professionals to keep them up and running. However, only about 4 percent of college graduates are receiving degrees in engineering or science while 50 to 85 percent of job growth is dependent on scientists and engineers. Because of this, our ability to turn out graduates in STEM fields, like engineering, is more important than ever.⁹

E. Relevance to high demand programs at Historically Black Institutions (HBIs) (do not put N/A as a response):

1. Discuss the program's potential impact on the implementation or maintenance of high-demand programs at HBI's.

The proposed A.S. in Engineering degree program with concentrations in mechanical/civil and chemical/biomedical will not have an impact on the development and continuance of high demand programs at HBI's. Maryland's HBIs include Bowie State University, Coppin State University, Morgan State University, and the University of Maryland Eastern Shore. None offer associate degree programs and only two have bachelor degree programs in engineering.

F. Relevance to the identity of Historically Black Institutions (HBIs) (do not put N/A as a response):

⁸ EducatingEngineers.com, *Maryland Engineering Schools on the Internet* at <http://educatingengineers.com/states/maryland> (Visited October 10, 2018).

⁹ Wired Cosmos, *Why America Desperately Needs More Scientists & Engineers* on the Internet at <http://wiredcosmos.com/2013/05/06/why-america-desperately-needs-more-scientists-engineers> (visited October 17, 2018).

1. Address any potential collaboration between an HBCU and the proposing institution. Refer to the articulation of the proposed program into undergraduates program as an HBCU, or the development of joint or dual degrees.

At this time, no collaborative agreements exist between CCC and the HBCUs in the region.

G. Adequacy of curriculum design, program modality, and related learning outcomes (as outlined in COMAR 13B.02.03.10):

1. Describe how the proposed program was established, and also describe the faculty who will oversee the program.

This program was established by the College's full-time mathematics and engineering faculty in the response to the need of a general engineering program. The program will be overseen by Tricia Crosset who will also teach the general engineering courses.

2. Describe educational objectives and learning outcomes appropriate to the rigor, breadth, and (modality) of the program.

Upon completion of the Associate of Science degree in engineering with concentrations in mechanical/civil and chemical/biomedical, students will:

- Have acquired a foundation of relevant mathematical, scientific, and fundamental engineering knowledge, including the use of computer tools and applications.
- Apply mathematics, science, and engineering knowledge to effectively engage in the engineering design process including identification of needs, development of practical solutions, analysis, and testing.
- Understand the collaborative nature of engineering and be able to effectively engage in teamwork and group projects.
- Understand and be able to apply the professional and ethical obligations of engineers and engineering solutions to employers and society.
- Be able to effectively communicate solutions to technical problems through oral and written technical presentations.

Student Learning Outcomes Assessment is a deliberate, systematic, and collaborative process driven by the College's commitment to improving student learning. It is a purposeful course of action that defines student accomplishments in terms of expected learning outcomes and core competencies. Actual student achievement is measured using established internal standards and external benchmarks. The outcomes assessment process is learning-centered and accumulates data from numerous sources to determine what students know, what skills they possess, how they conceptualize, and how they will continue to learn. The overall goal of assessment is to create a quality learning environment under ideal conditions through the use of best practices that inspire creativity, innovation, and critical thinking.

3. Explain how the institution will:
 - a. provide for the assessment of student achievement of learning outcomes in the program
 - b. document student achievement of learning outcomes in the program

Student Learning Outcomes Assessment is an ongoing component of the instructional process. All members of the institution share responsibility for student learning. Continuous improvement of learning is a collaborative enterprise upon which the success of instruction depends. The results of assessments are never used in a punitive manner toward students, faculty, or staff. The data collected during the assessment process is used to provide feedback to students and faculty, reinforcing and improving educational practices that facilitate learning.

The Engineering Associate of Science degree program with concentrations in mechanical/civil and chemical/biomedical will be evaluated at the course and program level on an annual basis. Resource allocation is driven by the needs addressed in the assessment process.

Each program at the College is required to assess one or two of its student learning objectives yearly. In addition, each program is subject to a comprehensive review every five years. Data from these processes are used for program improvement.

4. Provide a list of courses with the title, semester credit hours and course descriptions, along with a description of program requirements.

See Appendix A for program course and credit requirements and Appendix B for course descriptions. There are no special admission requirements for the program.

5. Discuss how general education requirements will be met, if applicable.

As an A.S. degree program, students will be required to complete a minimum of 28 credits in General Education courses. CCC has seven General Education goals that meet the Code of Maryland Regulations (COMAR) regulations. Specific courses have been identified within the curriculum that will be used to assess these general education competencies.

- 1) Communication (Written and Oral)

Students will communicate effectively in writing and in speech, and interpret the written and oral expressions of others.

- Assess and address a specific audience to accomplish a goal
- Craft an arguable thesis statement and support it with evidence
- Explore and respond to differing perspectives
- Use standard English in academic and professional settings

- 2) Critical Thinking

Students will practice analytical and evaluative thinking with a view toward continuous improvement.

- Independently identify problems and pose questions
- Gather, read, evaluate, and integrate relevant information
- Explore alternative perspectives and their implications
- Draw well-reasoned conclusions

- 3) Quantitative and Scientific Reasoning

Students will apply mathematical and scientific concepts and theories to identify and analyze a problem-solving situation.

- Apply models and methods to define, represent, and solve mathematical and scientific problems
- Make observations, identify problems, formulate questions and hypotheses
- Collect and interpret data in order to draw valid conclusions and identify logical relationships
- Distinguish scientific arguments from non-scientific arguments

4) Information & Technology Literacy

Students will research, create, and communicate information through appropriate technology.

- Select appropriate search methods for gathering information
- Evaluate the authority, reliability, accuracy, and currency of information sources
- Demonstrate an awareness of the ethical, legal, and cultural issues and responsibilities in the uses of information and technology
- Design, develop, and produce media that effectively communicate information and ideas

5) Creativity

Students will explore and appreciate the creative processes that shape the human experience.

- Appreciate creative expression as a reflection of culture and history
- Identify how creative processes lead to discovery and innovation
- Define and analyze stylistic nuances in artistic forms
- Examine a significant work of art or a great idea and its cultural influence

6) Global Awareness

Students will acknowledge and comprehend the beliefs, behaviors, and values of diverse populations within a global environment.

- Analyze and evaluate the significance of cultures and societies from a variety of perspectives
- Explain the impact of economic, political, and technological changes on diverse cultures
- Examine the interdependence of humanity
- Appreciate the commonalities and the differences among world cultures

7) Personal Development and Social Responsibility

Students will recognize and engage in personal and social behaviors responsible for the wellness of self and community.

- Develop a framework for ethical decision making and personal responsibility
- Examine how personal behaviors affect self and others
- Collaborate with others to achieve a common goal
- Participate in and reflect on personal learning experiences

6. Identify any specialized accreditation or graduate certification requirements for this program and its students.

There are no specialized accreditation or graduate certification requirements for this program. Students who complete this program will receive an A.S. in Engineering from CCC.

7. If contracting with another institution or non-collegiate organization, provide a copy of the written contract.

At this time, there are no agreements with other educational institutions or non-collegiate

organizations.

8. Provide assurance and any appropriate evidence that the proposed program will provide students with clear, complete, and timely information on the curriculum, course and degree requirements, nature of faculty/student interaction, assumptions about technology competence and skills, technical equipment requirements, learning management system, availability of academic support services and financial aid resources, and costs and payment policies.

As this program is in the proposal stage, specific evidence is not directly available for this program. However, the College will provide similar resources to students in the Engineering program as are provided for other programs. Information regarding curriculum, course, and degree requirements, including a suggested course sequence that demonstrates how the program can be completed in two years, is provided via the Carroll Community College Catalog (https://www.carrollcc.edu/uploadedFiles/CarrollCCedu/Content/PDF/Credit_Publications/Catalog/2018-2019%20Catalog%20for%20Web.pdf) and the Student Academic Planning tool, WebAdvisor, which requires a secure login and is individualized for each program and each student. Information about the learning management system (Blackboard), the availability of academic support services and financial aid resources, and costs and payment policies are found on various pages within the CCC website (<https://www.carrollcc.edu/home/>) and the secure internal CCC portal page (login required).

9. Provide assurance and any appropriate evidence that advertising, recruiting, and admissions materials will clearly and accurately represent the proposed program and the services available.

The Carroll Community College homepage links to seven major sections, two of which (Apply & Register and Programs & Courses) contain advertising, recruiting and admissions information. The information available includes, but is not limited to, admissions criteria and deadlines, academic program information, financial aid information and other information of interest to prospective students and their families. The Office of Academic Affairs works closely with the Offices of Admissions and Enrollment Development and Planning, Marketing, and Assessment to develop and maintain program-specific marketing materials.

H. Adequacy of Articulation

1. If applicable, discuss how the program supports articulation with programs at partner institutions. Provide all relevant articulation agreements.

Carroll Community College has the following articulation agreements for engineering students who wish to pursue a bachelor's degree:

- University of Maryland, Baltimore County
- University of Maryland, College Park

In addition, transfer agreements with other Maryland colleges and universities allow students to transfer credits into programs with partnering institutions.

I. Adequacy of faculty resources (as outlined in COMAR 13B.02.03.11):

1. Provide a brief narrative demonstrating the quality of program faculty. Include a summary list of faculty with appointment type, terminal degree title and field, academic title/rank, status (full-time, part-time, adjunct) and the course(s) each faculty member will teach (in this program).

No additional new faculty is needed for the A.S. in Engineering program with concentrations in mechanical/civil and chemical/biomedical at this time. There are a number of qualified full-time and adjunct faculty currently employed by the College to teach the General Education and Core Requirement portions of the program. The faculty members who will teach the Concentration courses in the program are listed below.					
Faculty Member	Degree Title	Degree Field	Academic Title/Rank	Full-time or Adjunct	Concentration Courses Taught
Jamshed Ayub	Ph.D.	Chemistry	Assistant Professor	Full-time	CHEM 106 – Principles of General Chemistry 2
Tricia Crosset	M.A.	Education/ Secondary Mathematics	Associate Professor	Full-time	ENGR 102 – Statics
	B.S.	Aerospace Engineering			
Raza Khan	Ph.D.	Chemistry	Associate Professor	Full-time	CHEM 201 – Organic Chemistry 1
Joseph Maranto	B.S.	Mechanical Engineering	Instructor 2	Adjunct	ENGR 220 – Mechanics of Materials
Janice Stencil	M.S.	Mathematics Education	Assistant Professor	Full-time	MATH 205 – Multivariable Calculus MATH 215 – Differential Equations
	B.S.	Mathematics			

2. Demonstrate how the institution will provide ongoing pedagogy training for faculty in evidence-based best practices, including training in:
 - a. pedagogy that meets the needs of the students
 - b. the learning management system
 - c. evidenced-based best practices for distance education, if distance education is offered

Training in pedagogy that meets the needs of students is provided through yearly through the use of Teaching Squares, mentoring, faculty coaching, and faculty workshops and supported by evidence-based best practices. Training for those new to the college’s learning management system, Blackboard, is offered through open drop-in workshops every week. The college supports faculty attendance at related regional and national conferences.
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J. Adequacy of library resources (as outlined in COMAR 13B.02.03.12):

1. Describe the library resources available and/or the measures to be taken to ensure resources are adequate to support the proposed program. If the program is to be implemented within

existing institutional resources, include a supportive statement by the President for library resources to meet the program's needs.

The college previously had an Arts and Sciences program with an Engineering Transfer Recommendation. That program was accidentally discontinued by the college in 2017 when MHEC required all Transfer Recommendations to be converted to areas of concentration. Since 2010 the college has also had a Computer Engineering Associate of Science in Engineering (A.S.E.) program and an Electrical Engineering Associate of Science in Engineering (A.S.E.) program. Because of the existence of these programs, the library already has adequate resources to support the program.

K. Adequacy of physical facilities, infrastructure and instructional equipment (as outlined in COMAR 13B.02.03.13):

1. Provide an assurance that physical facilities, infrastructure, and instruction equipment are adequate to initiate the program, particularly as related to spaces for classrooms, staff and faculty offices, and laboratories for studies in the technologies and sciences. If the program is to be implemented within existing institutional resources, include a supportive statement by the President for adequate equipment and facilities to meet the program's needs.

Current physical facilities and infrastructure at Carroll Community College are adequate to offer the new degree program without the need for additional resources.

Classrooms are equipped with the latest and updated instructional equipment which includes computers, audio and visual devices including projectors. Carroll's Information Technology department supports this equipment with software updates and any maintenance or repairs necessary to maintain quality instruction.

Computers are available for student, faculty and staff use in classrooms, computer labs, and the library. Free printing and wireless internet access can be found in all those locations.

The Testing Center is available to instructors for students with disability accommodation needs.

The advising staff provides course information that will assist students interested in pursuing the study of engineering.

The College complies with the American with Disabilities Act and has the necessary infrastructure and instructional equipment for ADA accommodations. The Office of Student Support Services provides the evaluations for ADA accommodations.

2. Provide assurance and any appropriate evidence that the institution will ensure students enrolled in and faculty teaching in distance education will have adequate access to:
 - a. an institutional electronic mailing system, and
 - b. a learning management system that provides the necessary technical support for distance education

Carroll Community College faculty receive an employee e-mail address and access to the college e-mail system on their first day of employment. Students receive a student e-mail address upon enrollment. Students receive access instructions at the e-mail address listed on their application.

Students are requested to activate their college e-mail account immediately and must use that e-mail address for all College correspondence. Once activated, this is also the only e-mail address that the college will use to contact students. Students are asked to check their Carroll e-mail, even when classes are not in session.

To facilitate learning, all credit-courses use Blackboard (Bb), Carroll's learning management system. Blackboard sites support easy access to course materials, interactions with the instructor and other students, course grades, and much more. Students are automatically enrolled into Blackboard course sites. Faculty members are given Blackboard assess and training within their first week of employment. At a minimum, faculty members are required to use Blackboard to post their syllabus, faculty contact information, and announcements and course communications. In addition, the grade book within Blackboard must be used to provide students with a reasonable understanding of the status of their grades through the duration of the course.

L. Adequacy of financial resources with documentation (as outlined in COMAR 13B.02.03.14):

1. Complete Table 1: Resources and Narrative Rationale. Provide finance data for the first five years of the program implementation. Enter figures into each cell and provide a total for each year. Also, provide a narrative rationale for each resource category. If resources have been or will be reallocated to support the proposed program, briefly discuss the sources of those funds.

TABLE 1: RESOURCES:					
Resource Categories	Year 1	Year 2	Year 3	Year 4	Year 5
	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024
1. Reallocated Funds	0	0	0	0	0
2. Tuition/Fee Revenue (c + g below)	\$29,315	\$42,272	\$57,020	\$67,248	\$86,838
a. Number of F/T Students	5	8	10	12	16
b. Annual Tuition/Fee Rate	\$3,907	\$4,024	\$4,145	\$4,269	\$4,398
c. Total F/T Revenue (a x b)	\$19,535	\$32,192	\$41,450	\$51,228	\$70,368
d. Number of P/T Students	4	4	6	6	6
e. Credit Hour Rate	\$163	\$168	\$173	\$178	\$183
f. Annual Credit Hour Rate	15	15	15	15	15
g. Total P/T Revenue (d x e x f)	\$9,780	\$10,080	\$15,570	\$16,020	\$16,470
3. Grants, Contracts & Other External Sources	0	0	0	0	0

4. Other Sources	0	0	0	0	0
TOTAL (Add 1 – 4)	\$29,315	\$42,272	\$57,020	\$67,248	\$86,838

Narrative for Table 1: Resources

1. Reallocated Funds: Carroll Community College does not anticipate any need to reallocate funds from any other area to support this program.
 2. Tuition and Fee Revenue: The cost of both full-time and per-credit tuition is subject to a 3% increase each year.
 3. Grants and Contracts: Not applicable.
 4. Other Sources: Tuition will be the only resource to support this program.
2. Complete Table 2: Program expenditures and Narrative Rationale. Provide finance data for the first five years of the program implementation. Enter figures into each cell and provide a total for each year. Also, provide a narrative rationale for each expenditure category.

TABLE 2: EXPENDITURES:					
Expenditure Categories	Year 1	Year 2	Year 3	Year 4	Year 5
	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024
1. Faculty (b + c below)	0	0	0	\$79,562	\$81,949
a. # FTE	0	0	0	1	1
b. Total Salary	0	0	0	\$58,935	\$60,703
c. Total Benefits	0	0	0	\$20,627	\$21,246
2. Admin. Staff (b + c below)	0	0	0	0	0
a. # FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
3. Support Staff (b + c below)	0	0	0	0	0
a. # FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0

4. Equipment	0	0	0	0	0
5. Library	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	\$2,000	\$2,000	\$1,000	\$1,000	\$1,000
TOTAL (Add 1 – 7)	\$3,000	\$3,000	\$3,000	\$82,562	\$84,949

Narrative for Table 2: Expenditures

1. Faculty (#FTE, Salary, and Benefits):
Carroll Community College already has one full-time Engineering faculty member on staff. With program growth, it is estimated that an additional faculty member will be needed beginning in year four.
2. Administrative Staff:
No additional administrative staff is expected in the first five years of the program.
3. Support Staff:
No additional support staff is expected in the first five years of the program.
4. Equipment:
No additional equipment is expected in the first five years of the program.
5. Library:
The current library loan mechanism and the electronic retrieval methods will be used for the Engineering program. Even though it is not anticipated that any new library holdings will be required, for the betterment of students who wish to become members of professional organizations or go beyond the required expectations, the Division will request that the library invests in subscriptions to one or two professional journals.
6. New or Renovated Space:
No new or renovated space needs are expected in the first five years of the program.
7. Other Expenses:
Marketing and faculty development expenses are expected in the first five years of the program.

M. Adequacy of provisions for evaluation of program (as outlined in COMAR 13B.02.03.15):

1. Discuss procedures for evaluating courses, faculty and student learning outcomes.

Students in the Engineering A.S. program with concentrations in mechanical/civil and chemical/biomedical will be required to demonstrate their competency with regard to the stated learning outcomes for each course and the program. This will be achieved through various deliverables, which include projects, written quizzes and exams, exercises, written assignments, and oral presentations. Courses and faculty will be evaluated based on how effective they cover the stated learning goals, as well as through the parameters outlined in the student evaluation process.

The College has a rigorous course and program assessment process. Course assessment takes place by using signature assignments that address specific course outcomes. Data from these course

assessments are collected and analyzed to improve courses and to ensure program learning outcomes are met.

2. Explain how the institution will evaluate the proposed program's educational effectiveness, including assessments of student learning outcomes, student retention, student and faculty satisfaction, and cost-effectiveness.

At the program level, the Program Director and faculty conduct and document an annual assessment report of select objectives that are chosen and responded to on a yearly basis. In addition, as part of the quality improvement process, a comprehensive program review is conducted once every five years. The purpose of the review is to evaluate the effectiveness of the academic program through the evaluation of curriculum, faculty, student enrollment and retention, and student learning outcomes. Each program has an advisory board consisting of professionals in the field to assist in the construction and analysis of program review data. The information collected is used to determine many things, including cost-effectiveness and program viability. The review process ensures that the following are reflected in the document:

- a. the mission of the college and how the needs of the community are met
- b. student performance
- c. transferability and /or workforce applicability
- d. curriculum strengths and weakness
- e. adequacy of resources to support the program

The Vice President of Academic and Student Affairs, along with the Student Learning Improvement Committee, the General Education Committee, and the Program Review Committee coordinate these processes.

N. Consistency with the State's minority student achievement goals (as outlined in COMAR 13B.02.03.05 and in the State Plan for Postsecondary Education):

1. Discuss how the proposed program addresses minority student access & success, and the institution's cultural diversity goals and initiatives.

Carroll Community College is committed to the recruitment and retention of minority students and will expand its services and policies to include the Engineering program students. The College employs broad recruitment efforts to attract a racially diverse student body and support them with the services they need to be retained and successful. The entire staff supports the College goal of providing a "safe learning environment that models respect, acceptance, inclusion, and empathy towards diverse ways of thinking and being." Statements of non-discrimination are included in College publications and will appear in any marketing pieces for the programs.

O. Relationship to low productivity programs identified by the Commission:

1. If the proposed program is directly related to an identified low productivity program, discuss how the fiscal resources (including faculty, administration, library resources, and general operating expenses) may be redistributed to this program.

Currently, there are no low-productivity programs at the College which can be redirected.

P. Adequacy of Distance Education Programs (as outlined in COMAR13B.02.03.22)

1. Provide affirmation and any appropriate evidence that the institution is eligible to provide distance education.

In January 2018, the Middle States Commission on Higher Education confirmed that Carroll Community College had completed the review process and was approved to offer academic programs for which 50 percent or more of the degree or academic program will be offered through an alternative method of delivery without additional approvals. Notification of such was sent to the Maryland Higher Education Commission on April 27, 2018.

2. Provide assurance and any appropriate evidence that the institution complies with the C-RAC guidelines, particularly as it relates to the proposed program.

The College follows the C-RAC guidelines to assure comparable national standards for interstate offering of postsecondary distance education courses and programs.

APPENDICES

**Engineering A.S.
Program Course and Credit Requirements**

Course Prefix and Number	Course Title	Credits
General Education Requirements		
<i>Arts and Humanities</i>		6
<i>Biological and Physical Sciences</i>		8
CHEM 105	General Chemistry 1	
PHYS 111	Physics 1 for Scientists and Engineers	
<i>English Composition and Literature</i>		3
<i>Mathematics</i>		4
MATH 135	Calculus of a Single Variable 1	
<i>Social and Behavioral Sciences</i>		6
ENGR 100	Introduction to Engineering	
ECON 102	Principles of Macroeconomics	
<i>General Education Elective</i>		3
Total General Education Requirements		30
Core Requirements		
MATH 136	Calculus of a Single Variable 2	4
PHYS 212	Physics 2 for Scientists and Engineers	4
Total Core Requirements		8
General Engineering Concentration Requirements		
MATH 205	Multivariable Calculus	4
MATH 215	Differential Equations	4
	Electives	14
Total General Engineering Concentration Requirements		22
Mechanical/Civil Concentration Requirements		
ENGR 102	Statics	3
ENGR 220	Mechanics and Materials	3
MATH 205	Multivariable Calculus	4
MATH 215	Differential Equations	4
	Electives	8
Total Mechanical/Civil Concentration Requirements		22
Chemical/Biomedical Concentration Requirements		
CHEM 106	Principles of General Chemistry 2	4
CHEM 201	Organic Chemistry 1	5
MATH 205	Multivariable Calculus	4
	Electives	9
Total Chemical/Biomedical Concentration Requirements		22
A.S. Engineering Degree Total		60

Notes:

*Students should meet with an Engineering faculty advisor to discuss the choice of electives based on transfer preferences.

**One course (3 credits) from Arts and Humanities or General Education Electives (or second Social and Behavioral Sciences course) must meet Diversity/World View requirement.

Engineering A.S. Course Descriptions

General Education Courses

Arts and Humanities Electives – 6 credits

Biological and Physical Sciences Electives – 8 credits

CHEM-105, General Chemistry 1, is the first-semester course for students who intend to major in chemistry, life sciences and other areas that require a minimum of one semester and/or one year of college chemistry. Topics covered in the course include the study of matter and measurements, atoms, molecules and ions, stoichiometry involving chemical reactions, solution stoichiometry, thermochemistry, the electronic structure of the atom, periodic properties, chemical bonding, molecular geometry, and the physical behavior of gases. Advanced Placement Exam (Chemistry with a score of 4) accepted. Prerequisite: C grade or better in CHEM-101 (or eligible for ENGL-101 and high school chemistry with advisor signature) and MATH-123. Three hours lecture and three hours laboratory each week. Four credits. Four billable hours.

PHYS-111, Physics 1 for Scientists and Engineers, is the first semester of a three-semester calculus-based physics course intended for physics, physical science, engineering, and related science majors. The course will enable the student to solve problems for the major concepts in mechanics and particle dynamics including measurement, vector concepts, kinematics, dynamics, statics, gravitation, energy, momentum, rotation dynamics, and fluids. The student will interpret and apply the experimental laws and fundamental principles of physics to describe the behavior of the physical world. In the laboratory program, the student will develop the ability to collect, appraise, use, and interpret data in order to express mathematically or explain the physical phenomena observed. Credit will not be given for both PHYS-101 and PHYS-111. Prerequisite: MATH-135 with a grade of C or better and concurrent enrollment in MATH-136. Three hours lecture, three hours laboratory each week. Four credits. Four billable hours.

English Composition – 3 credits

Mathematics – 4 credits

MATH-135, Calculus of a Single Variable 1, Calculus of a Single Variable 1 introduces the initial concepts of both differential and integral calculus. The concept of limits will be introduced both informally and through the formal epsilon-delta process. Derivatives and integrals of polynomial, power, and trigonometric functions will be developed as well as general differentiation techniques (such as the chain rule and implicit differentiation). Evaluation of definite integrals will be covered through limits of Riemann Sums, numerical integration techniques, and the Fundamental Theorems of Calculus. Applications of calculus to graphing and to physical situations will be extensively developed. Prerequisite: exemption/completion of READ A-F, plus MATH-123/MATH-124 or MATH-130 with a C grade or better, or satisfactory scores on the placement exam. Credit by exam available. Five hours lecture each week. Four credits. Four billable hours.

Social and Behavioral Sciences – 6 credits

ENGR 100, Introduction to Engineering: Professional, Social and Ethical Dimensions, is an introduction to the engineering profession. Students explore the process and collaborative nature of engineering, the

theories, and practice associated with creativity, critical thinking, and constructive interpersonal working relationships, the engineer's role in society, and the impact of technology on society. The engineering design process, from recognition of a specific need to final production of a product, is introduced. Emphasis is placed on foundational theories for productively working in a team and for effective communication with technical and non-technical audiences. Students work in project teams to realize solutions to specific needs, providing opportunities for the development of these personal skills and for learning how to create the technical documentation necessary to represent and communicate their solutions. Prerequisite: Eligible for ENGL-101 and a C or better in MATH-124 or MATH-130. Two hours lecture and two hours laboratory each week. Three credits. Three billable hours. Offered fall term only.

ECON-102, Principles of Macroeconomics, introduces students to concepts, theories, and issues impacting the economy overall. Topics include economic systems, scarcity and opportunity cost, supply and demand, unemployment and inflation, GDP and economic growth, fiscal and monetary policies, and international trade. Advanced Placement Exam (Macro Economics with a score of 3) and CLEP (Macro Economics with a score of 50) accepted. Prerequisite: Eligible for ENGL-101. Three hours lecture each week. Three credits. Three billable hours.

General Education Elective – 3 credits

Core Requirements

MATH -136: Calculus of a Single Variable 2, expands the group of functions whose derivatives and integrals are studied in MATH-135. Functions added are the exponential, logarithmic, inverse trigonometric and hyperbolic functions. Infinite sequences and series, including convergence tests, power series and Taylor and Maclaurin series, are studied. An introduction is given for conic sections, and derivatives and integrals in parametric and polar coordinates are covered. Students will be required to use mathematical software such as Mathematica, Maple, or MATLAB throughout the course. Prerequisite: MATH-135 with a C grade or better. Five hours lecture each week. Four credits. Four billable hours.

PHYS-212, Physics 2 for Scientists and Engineers, is the second semester of a three-semester calculus-based physics course. The course will enable the student to solve problems, using calculus methods when applicable, for the major concepts in physics to include: kinetic theory, heat and thermodynamics, electrostatics, electricity through the fundamentals of DC and AC circuits, magnetic and induction, and EM waves. The student will interpret and apply the experimental laws and fundamental principles of physics to describe the behavior of the physical world. In the laboratory, the student will develop the ability to collect, appraise, use, and interpret data in order to express mathematically and/or explain the physical phenomena observed. Prerequisite: PHYS-111 and MATH-136, both with C grades or higher. Three hours lecture and three hours laboratory each week. Four credits. Four billable hours.

Concentration Requirements

CHEM-106, General Chemistry 2, is a continuation of CHEM 105 for students who intend to major in chemistry, life sciences and other areas that require a minimum of one semester and/or one year of college chemistry. Topics covered in the course include the study of intermolecular forces in liquids and solids, phase changes, properties of solutions, chemical kinetics, gaseous and aqueous equilibria, acids

and bases, chemical thermodynamics, electrochemistry, and introduction to nuclear, organic and biological chemistry. Prerequisite: CHEM-105 and MATH-123 with C grades or better. Three hours lecture and three hours laboratory each week. Four credits. Four billable hours.

CHEM-201, Organic Chemistry 1, is the first-semester course in college level organic chemistry. This course fulfills the requirements for students who are chemistry majors, life science majors or pursuing other majors that require college-level organic chemistry. Topics covered in the course include foundational aspects of hydrocarbons and their select derivatives including functional groups on their structure, stereochemistry, reactions, and acid-base chemistry. Prerequisite: CHEM-106 with a grade of C or better. Three hours lecture and four hours laboratory each week. Five credits. Five billable hours. Offered fall term only.

ENGR-102, Statics, studies the equilibrium of stationary bodies under the influence of various kinds of forces. Topics studied include forces, moments, couples, equilibrium, frames and machines, centroids, moments of inertia, and friction. Vector and scalar methods are used to solve problems. Prerequisites: PHYS-111 and MATH-135, both with a minimum grade of C or better. Three hours lecture each week. Three credits. Three billable hours. Offered fall term only.

ENGR -220, Mechanics and Materials, studies the distortion of engineering materials in relation to changes in stress or temperature. The geometry of internal strain and external displacement will be studied. Applications will be presented and discussed which cover beams, columns, shafts, tanks and other structural machine and vehicle members. Prerequisites: PHYS-111, ENGR-102, and MATH-136, each with a minimum C. Three hours lecture each week. Three credits. Three billable hours. Offered spring term only.

MATH-205, Multivariable Calculus, continues MATH-136 with vectors and analytic geometry in three dimensions, partial derivatives, multiple integrals, line and surface integrals, and vector field theory. Students will be required to use a graphing calculator and significant mathematical software such as Mathematica, Maple, or MATLAB throughout the course. Prerequisite: MATH-136 with a C grade or better. Five hours lecture each week. Four credits. Four billable hours.

MATH-215, Differential Equations, includes exact solutions of common types of first-order ordinary differential equations, exact solutions of second-order equations whose coefficients are constant, power series solutions, numerical and graphical techniques, Laplace transform methods and linear systems. Additional topics may include applications to geometry and mechanics, matrix methods, special functions, and non-linear systems. Students will be required to use a graphing calculator and significant mathematical software such as Mathematica, Maple, or MATLAB throughout the course. Prerequisites: MATH-136 with a C grade or better. Five hours lecture each week. Four credits. Four billable hours.

Electives

CAD-101, Introduction to Computer-Aided Design and Drawing, is a basic course in Computer-Aided Design. Content stresses learning major CAD commands and using the graphic user interface. Conceptual drawing and spatial relationships, as well as file maintenance and plotting output, are used to create two-dimensional design models. Prerequisite: exemption/completion of READ A-D or ENG-001 and MAT-095 or MAT-097. Two hours lecture, two hours laboratory each week. Three credits. Three billable hours.

CHEM-106, General Chemistry 2, is a continuation of CHEM 105 for students who intend to major in chemistry, life sciences and other areas that require a minimum of one semester and/or one year of college chemistry. Topics covered in the course include the study of intermolecular forces in liquids and solids, phase changes, properties of solutions, chemical kinetics, gaseous and aqueous equilibria, acids and bases, chemical thermodynamics, electrochemistry, and introduction to nuclear, organic and biological chemistry. Prerequisite: CHEM-105 and MATH-123 with C grades or better. Three hours lecture and three hours laboratory each week. Four credits. Four billable hours.

CHEM-201, Organic Chemistry 1, is the first-semester course in college level organic chemistry. This course fulfills the requirements for students who are chemistry majors, life science majors or pursuing other majors that require college-level organic chemistry. Topics covered in the course include foundational aspects of hydrocarbons and their select derivatives including functional groups on their structure, stereochemistry, reactions, and acid-base chemistry. Prerequisite: CHEM-106 with a grade of C or better. Three hours lecture and four hours laboratory each week. Five credits. Five billable hours. Offered fall term only.

CHEM-202, Organic Chemistry 2, is the second-semester course in college level organic chemistry. This course fulfills the requirements for students who are chemistry majors, life science majors or pursuing a major that requires a two-semester sequence of college-level organic chemistry. Topics covered in the course include nomenclature, structural determination, and mechanisms of reactions of functional groups including biomolecules. Prerequisite: CHEM-201 with a grade of C or better. Three hours lecture and four hours laboratory. Five credits. Five billable hours. Offered spring term only.

CIS-132, Principles of Programming, introduces the student to object-oriented programming. Students will learn how to write code and develop strategies to solve problems. Topics covered include: creating classes, decision structures, loops, file I/O, arrays, text processing, and wrapper classes. Prerequisite: Any General Education Mathematics course. Three hours lecture, two hours laboratory each week. Four credits. Four billable hours.

ENGR-102, Statics, studies the equilibrium of stationary bodies under the influence of various kinds of forces. Topics studied include forces, moments, couples, equilibrium, frames and machines, centroids, moments of inertia, and friction. Vector and scalar methods are used to solve problems. Prerequisites: PHYS-111 and MATH-135, both with a minimum grade of C or better. Three hours lecture each week. Three credits. Three billable hours. Offered fall term only.

ENGR-221, Dynamics, introduces students to systems of heavy particles and rigid bodies at rest and in motion in a plane and in three-dimensional space. Force-acceleration, work-energy, and impulse-momentum relationships will be studied and applied. Prerequisites: PHYS-111, ENGR-102, and MATH-136, each with a minimum C. Three hours lecture each week. Three credits. Three billable hours. Offered Spring term only.

MATH-210, Linear Algebra, includes vector spaces, linear transformations, matrices and determinants, quadratic forms, Eigenvalues, and similarity. Applications to geometry, systems of linear equations, and function spaces (including Fourier analysis) are included. Students will be required to use a graphing calculator and significant mathematical software such as Mathematica, Maple, or MATLAB throughout the course. Prerequisite: MATH-136 with a C grade or better. Five hours lecture each week. Four credits. Four billable hours. Offered spring term only.

MATH-215, Differential Equations, includes exact solutions of common types of first-order ordinary differential equations, exact solutions of second-order equations whose coefficients are constant, power series solutions, numerical and graphical techniques, Laplace transform methods and linear systems. Additional topics may include applications to geometry and mechanics, matrix methods, special functions, and non-linear systems. Students will be required to use a graphing calculator and significant mathematical software such as Mathematica, Maple, or MATLAB throughout the course. Prerequisites: MATH-136 with a C grade or better. Five hours lecture each week. Four credits. Four billable hours.

PHYS-213, Physics 3 for Scientists and Engineers, is the third semester of three-semesters of calculus-based physics courses. The course will enable the student to solve problems, using calculus methods when applicable, for the major concepts in physics to include: waves and wave mechanics, electromagnetic waves, physical and geometric optics, relativity, atomic and molecular structure, nuclear physics and radioactivity, and an introduction to quantum mechanics. The student will interpret and apply the experimental laws and fundamental principles of physics to describe the behavior of the physical world. In the laboratory, the student will develop the ability to collect, appraise, use, and interpret data in order to express mathematically and/or explain the physical phenomena observed. Prerequisite: PHYS-212 and MATH-136, both with C grades or higher and concurrent enrollment in MATH-205. Three hours lecture, three hours laboratory each week. Four credits. Four billable hours.