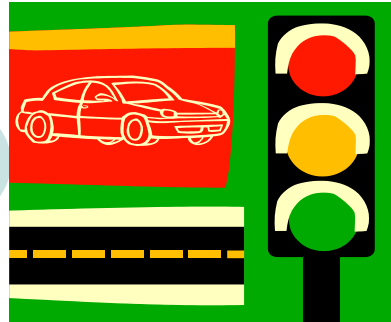


HOWARD UNIVERSITY

Department of Civil and Environmental Engineering

2011 Undergraduate Curriculum



EFFECTIVE FALL 2011
Revised 11/25/11

HOWARD UNIVERSITY
Civil and Environmental Engineering Undergraduate Curriculum

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HOWARD UNIVERSITY
Civil and Environmental Engineering
UNDERGRADUATE PROGRAM

EFFECTIVE FALL 2011

PROGRAM EDUCATIONAL OBJECTIVES

Three to five years after graduating from our civil engineering program, successful graduates will:

1. Analyze and design contemporary civil engineering systems independently and as members or leaders of multidisciplinary teams. (Maps to outcomes b, c, d, j, k)
2. Pursue graduate and professional studies and/or professional development opportunities, including those required to pursue and maintain professional registration. (Maps to outcomes: h, i)
3. Utilize their knowledge, problem-solving, and communication skills in professional careers in government agencies and the private sector. (Maps to outcomes: a, e, f, g)

The program offers instruction and research opportunities in **environmental, geotechnical, structural, transportation, and water resources engineering** and has adopted the student outcomes established by ABET requirements in Criterion 3. Achieving these outcomes establishes the foundation for achieving the program educational objectives.

DEGREE REQUIREMENTS

To meet the requirements for graduation, a student must successfully complete the required 127 credits of course work with a minimum overall cumulative grade point average (GPA) of 2.0 and a minimum GPA of 2.0 in civil and environmental engineering courses.

Table 1. Degree Requirements Overview

Subject Area	Total Credit Hours
English	6
Math and Basic Science	35
Social Science/Humanities	9
African-American Studies	3
ROTC / Physical Education	2
Engineering	69
Free Elective	3
Total Credit Hours	127

SPECIAL SERVICES FOR STUDENTS WITH DISABILITIES

Howard University is committed to providing an educational environment that is accessible to all students. In accordance with this policy, students in need of accommodations due to a disability should contact the *Office of the Dean for Special Services* for verification and determination of reasonable

accommodations as soon as possible after admission/registration to the University, or at the beginning of each semester. The Dean of the Office of Special Services can be contacted at (202) 238-2420.

CIVIL ENGINEERING PROGRAM OUTCOMES

Program outcomes define what students are expected to know or be able to do by the time of graduation. The civil engineering program has adopted the program **outcomes** established by ABET requirements in Criterion 3. Achieving these outcomes is the foundation for the program educational objectives. The specific program outcomes are listed below.

Students completing the civil engineering program will be able to demonstrate:

- 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
- d). an ability to function on multi-disciplinary teams
- e). an ability to identify, formulate, and solve engineering 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 and societal context
- i). a recognition of the need for, and an ability to engage in life-long learning
- j). a knowledge of contemporary issues
- k). an ability to use the techniques, skills, and modern engineering tools necessary for engineering.

CODE OF ETHICS OF ENGINEERS

Engineers are expected to uphold and advance the integrity, honor and dignity of the engineering profession by:

- ◆ Using their knowledge and skills for the enhancement of human welfare;
- ◆ Being honest and impartial, and serving with fidelity the public, their employers and clients;
- ◆ Striving to increase the competence and prestige of the engineering profession; and
- ◆ Supporting the professional technical societies of their disciplines.

The Fundamental Canons:

1. Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
2. Engineers shall perform services only in the areas of their competence.
3. Engineers shall issue public statements only in an objective and truthful manner.
4. Engineers shall act in professional manners for each employer or client as faithful agents or Trustees, and shall avoid conflicts of interest.
5. Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.
6. Engineers shall act in such a manner as to uphold and enhance the honor, integrity and dignity of the profession.

7. Engineers shall continue their professional development throughout their careers and shall provide opportunities for the professional development of those engineers under their supervision.

TRANSFER CREDIT

All courses that are taken at external institutions, which a student would like to have considered as part of the curriculum for the **Bachelor of Science degree in Civil Engineering**, must be approved by the Department. Continuing students must consult their advisors prior to taking courses from other institutions. Students desiring to transfer courses must provide transcripts and course descriptions from source institutions to the Chair. The Chair, in consultation with faculty, decides the merits of a transfer request in the context of curriculum requirements. Upon approval, the Department will prepare the application for Advance Standing that will enable approved courses to transfer to the student's transcript.

TRACKING PROGRESS

Students are encouraged to use this Undergraduate Curriculum to plan and track their progress during their period of study. At the beginning of the academic year of graduation, each student must also complete a curriculum check sheet that shows all the courses he or she has taken or transferred. Both the student and his/her academic advisor must review and sign the check sheet. Then, the student must submit the check sheet to the Department of Civil Engineering Administrative Assistant.

I. Academic Advisement

The role of your primary faculty advisor goes beyond providing assistance to our students in selecting and scheduling classes. The scope of the advisor's responsibility typically includes any areas that affect or are related to student's academic success, such as: goal setting, career planning, academic issues, personal concerns, financial support, and general guidance to facilitate personal growth. All of our students are expected to get to know their assigned advisors beyond the basic advisory function.

During general registration periods all students are required to meet with their assigned faculty advisors to complete registration requirements of the University and the Department. An advisor's assistance is invaluable in helping students define a given program of study or career goal. The advisor's and the student's signatures are required on all registration request forms. Completed Registration Request Form serves as evidence of consultation with the advisor approval selection of courses. Students who violate pre-requisite/co-requisites or register for courses that were not approved by the advisor risk being dropped from courses.

Students can meet with their advisor during office hours or schedule an appointment. Student should inform their advisors of any difficulties, so they can assist them with academic and personal challenges. Students can also arrange a meeting with the department chairperson and discuss any concerns or challenges.

II. Consortium Requirements

Students must be registered and validated at Howard University during the same semester they are interested in taking a Consortium course. The University offers its qualified undergraduate and graduate degree seeking students the opportunity to take consortium courses. To participate in the Consortium, a Howard University student must:

1. Be a fully admitted degree seeking student
2. Be actively enrolled in courses at Howard University at the same time that the Consortium course is being taken.

3. Not exceed the amount of credits they are registered for at Howard University.
4. Be in good academic standing- (2.0 GPA for undergraduate students and 3.0 for graduate students)
5. Validated for the current semester
6. Obtain the following approvals to participate in the Consortium Program.

Howard University participates in the Consortium with the following universities and colleges:

- ◆ American University
- ◆ Catholic University
- ◆ Gallaudet University
- ◆ Georgetown University
- ◆ George Mason University
- ◆ George Washington University
- ◆ Marymount College
- ◆ Mount Vernon College
- ◆ Southeastern University
- ◆ Trinity College
- ◆ University of the District of Columbia
- ◆ University of Maryland at College Park

Information and applications are available from the Consortium Coordinator in the Administration Building, Office of Records, Room 105.

III. Taking Courses from Other Institutions

All courses taken at external institutions must be pre-approved by the Department if such courses are to become part of your undergraduate degree program requirements. Approval by the Chairperson and your assigned advisor is essential.

DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING UNDERGRADUATE PLAN OF STUDY

FRESHMAN YEAR					
Course No	Course Title	Fall	Spring	Prerequisite	Co-requisite
EGPP-101	Intro to Engineering I	2			
MATH-156	Calculus I	4			
ENGL-002	Freshman Composition I	3			
CHEM-003	General Chemistry Lecture I	4			
CHEM-005	General Chemistry Lab I	1			
Electives	Humanities Elective	3			
CIEG-102	Intro to Civil Engineering		3	EGPP-101	
MATH-157	Calculus II		4	MATH-156	
ENGL-003	Freshman Composition II		3	ENGL-002	
PHYS-013	Physics/S&E Lecture I		3	MATH-156	PHYS-023
PHYS-023	Physics/S&E Lab I		1		PHYS-013
Electives	ROTC/Physical Education		1		
FRESHMAN YEAR TOTAL		17	15		
SOPHOMORE YEAR					
Electives	Basic Science Elective	3			
CIEG-202	Statics	3		MATH-157; PHYS-013	
MATH-158	Calculus III	4		MATH-157	
PHYS-014	Physics/S&E Lecture II	3		MATH-157; PHYS-013	PHYS-024
PHYS-024	Physics/S&E Lab II	1		PHYS-023	PHYS-014
Electives	Social Science Elective	3			
CIEG-302	Dynamics		3	CIEG-202	MATH-159
MATH-164	Numerical Methods		3	CIEG-102	MATH-159
CIEG-350	Engineering Economics		3	MATH-157	
CIEG-351	Probability & Statistics		3	MATH-158	
MATH-159	Differential Equations		4	MATH-157	
Electives	ROTC/Physical Education		1		
SOPHOMORE YEAR TOTAL		17	17		
JUNIOR YEAR					
CIEG-207	Intro to Environmental Engineering	3		CHEM-003	
CIEG-301	Mechanics of Materials Lecture	3		CIEG-302; MATH-159	MEEG 309
	Mechanics of Materials Laboratory	1			CIEG 301
CIEG-311	Fluid Mechanics Lecture	3		CIEG-302; MATH-159	
	Fluid Mechanics Laboratory	1			CIEG 311
MEEG 309	Materials Science	3		CHEM-003; PHYS 014	CIEG-301
Electives	African American Elective	3			
CIEG-314	Structures I		3	CIEG-301	
CIEG-352	Water Resources Engineering		3	CIEG-351	
CIEG-416	Transportation Engineering		3	CIEG 302; CIEG-350	
CIEG-434	Soil Mechanics Lecture		3	CIEG-301; CIEG 311	
	Soil Mechanics Laboratory		1		CIEG 434
Electives	Free Elective		3		
JUNIOR YEAR TOTAL		17	16		
SENIOR YEAR					
CIEG-439	Senior Design I	3		CIEG-207, 314, 352, 416, 434	
CIEG Electives	CIEG Discipline Elective 1	3			
CIEG Electives	CIEG Discipline Elective 2	3			
CIEG Electives	CIEG Discipline Elective 3	3			
CIEG Electives	CIEG Discipline Elective 4	3			
CIEG-441	Senior Design II		3	CIEG-439	
CIEG-462	Seminar I		1	CIEG-439	CIEG-441
Electives	Technical Elective 1		3		
Electives	Technical Elective 2		3		

Electives	Humanities or Social Science Elective		3		
SENIOR YEAR TOTAL		15	13		

CURRICULUM NOTES

IMPORTANT – Each student must abide by the prerequisite and co-requisite stipulations. All required courses for the undergraduate civil engineering program of the Department must not be taken out of sequence. To meet the requirements for graduation, a student must successfully complete the required **127 credit hours** of course work with a minimum overall cumulative grade point average of 2.0 and a minimum GPA of 2.0 in Civil Engineering courses. **Students are encouraged to take the Fundamentals of Engineering Exam (FE) in their senior year in the District of Columbia.**

(1) Every student taking mathematics courses at Howard University must take the **Mathematics Placement Examination** to determine the appropriate entry level mathematics course. Each student also must complete the minimum requirement of 16 mathematics credit hours by taking Calculus I, II, III and Differential Equations.

(2) **Department of Civil Engineering Policy Regarding Free Elective, African American Elective, Humanities and Social Sciences Course Requirements:** The Free Elective (see Table 6) is a three-credit course that is intended for students to explore a subject outside of, but related to, civil engineering. Students must also complete a three-credit course in African American studies (per University requirement), a three-credit Humanities course, a three-credit Social Sciences courses, and a second three-credit course in the Humanities or Social Sciences. Tables 3, 4, and 5 (on pages 12 thru 14) list the courses from which these elective selections must be made. Any exception to the courses listed in these tables must be requested, in writing, along with the course description to the student’s advisor for consideration and approval prior to enrollment.

(3) **Every student must complete any four of the following five CIEG Discipline Electives:**

- CIEG-328 Unit Operations in Environmental Engineering (Prerequisite: CIEG-207)
- CIEG-433 Foundation Engineering (Prerequisite: CIEG-434)
- CIEG-435 Reinforced Concrete (Prerequisite: CIEG-314)
- CIEG-457 Advanced Hydrology (Prerequisite: CIEG-352)
- CIEG-465 Traffic Engineering I (Prerequisites: CIEG-351; CIEG 416)

(4) **Department of Civil and Environmental Engineering Policy Regarding Senior Year Technical Electives:** Technical electives are intended to expand students’ basic knowledge of the civil engineering disciplines. Table 2 lists the courses from which technical elective selections must be made. Students should select technical electives from the same areas of concentration as their CIEG Discipline Electives. Students also have an opportunity to take courses through the Consortium and other University departments as technical electives, upon the approval of their advisor and the Department Chair.

(5) **Basic Science Elective:** Each student must select one (1) of the following basic science courses to fulfill the basic science elective requirement. Students have an opportunity to take additional basic science courses through the Consortium, upon the approval of their advisor and the Department Chair.

Note: Students must register for the lecture and lab.

- COMP-001 Life Sciences Lecture & Lab (3 credits)
- COMP-002 Planetary Science Lecture & Lab (3 credits)
- BIOL-101 General Biology Lecture & Lab (4 credits)

DESCRIPTION OF COURSES

Chemistry

CHEM-003. General Chemistry & Recitation, 4 credits. Deals with the fundamental principles of chemistry, the chemical and physical properties of the elements and their most common compounds, and methods of qualitative inorganic analysis. **Prereq:** Students required to take **CAR math** have to satisfy that requirement before they will be able to enroll in this course.

CHEM-005. General Chemistry Laboratory, 1 credit. Designed to teach some of the techniques of chemical experimentation, illustrate some of the principles of chemical substances.

Civil and Environmental Engineering

EGPP-101. Introduction to Engineering, 2 credits. Provides information on engineering education, the engineering profession, and basic concepts and tools. Introduces the engineering design process and provides the opportunity for students to complete engineering design projects.

CIEG-102. Introduction to Civil Engineering, 3 credits. Introduces the student to the disciplines within civil engineering and skills needed for success in the major and profession, including MathCAD. **Prereq.:** EGPP-101.

CIEG-202. Statics, 3 credits. Introduction to vectors, pseudo-graphical and analytical micro-computer aided resolution and composition of forces; equilibrium of collinear, concurrent, and non-concurrent two and three dimensional force systems, as applied to particles and rigid bodies. Coulomb friction; Hooke's law; introductory application of equilibrium, compatibility, and constitutive relations in the determination of forces moments, displacements and rotations of simple deformable bodies and biomechanical systems, using simple computer aids. **Prereq.:** MATH-157; PHYS-013.

CIEG-207. Introduction to Environmental Engineering, 3 credits. Introduces concepts in water supply, water and wastewater treatment, air quality, solid and hazardous waste management, and social and ethical considerations. Provides a brief history and background of environmental engineering. **Prereq.:** CHEM-003.

CIEG-301. Mechanics of Materials Lecture, 3 credits. Introductory analysis of tension, compression and shear; analysis of stress and strain; ties, shafts, beams and columns; related laboratory experiments and computer applications; introduction to structural analysis and design. This course must be taken during the same semester as CIEG-301b, Mechanics of Materials Lab. Exceptions must be approved by Instructor prior to course registration. **Prereq.:** MATH-159; **CIEG-302, Coreq.:** MEEG-309.

CIEG-301b. Mechanics of Materials Lab, 1 credit. Experimental laboratory to accompany Mechanics of Materials lecture. This course is a co-requisite of **CIEG 301, Mechanics of Materials Lecture**.

CIEG-302. Dynamics, 3 credits. Study of motions of particles; particle systems, rigid bodies and simple deformable mass system; rectilinear and curvilinear kinematics; Newton's laws of motion and gravitation; work energy and impulse-momentum principles; conservation laws for energy and momentum; introduction to vibrations; computer-aided applications. **Prereq.:** CIEG-202; **Coreq.:** MATH-159.

CIEG-311. Fluid Mechanics Lecture, 3 credits. Theoretical studies of fluid properties, hydrostatics, and kinematics of fluid motion; continuity; Bernoulli; impulse-momentum; drag and resistance to flow laboratory studies. This course must be taken during the same semester as CIEG-311b, Fluid Mechanics Lab. Exceptions must be approved by Instructor prior to course registration. **Prereq.:** MATH-159; **CIEG-302.**

CIEG-311b. Fluid Mechanics Lab, 1 credit. Experimental laboratory to accompany Fluid Mechanics lecture. This course is a co-requisite of **CIEG 311, Fluid Mechanics Lecture**.

CIEG-314. Structures I, 3 credits. Includes forms and concepts; statically determinate structures; and reactions, shears, moments, and deflections in beams, trusses, and frames. Introduction to design of simple elements and connections. **Prereq.: CIEG-301.**

CIEG-328. Unit Operations in Environmental Engineering, 3 credits. Analysis and basic design of treatment facilities for the remediation of air, water and land pollution. **Prereq.: CIEG-207.**

CIEG-350 Engineering Economics, 3 credits. Examines principles of accounting, time value of money, depreciation, taxes, retirement, and economic analysis of alternatives for use in personal finances and engineering projects. **Prereq.: MATH-157. {Note: replaces Engineering Systems Analysis}**

CIEG-351. Probability and Statistics, 3 credits. Introductory probability and statistics, probability theory, distribution, random variables, statistical analysis, confidence intervals, and hypothesis testing. **Prereq: MATH-158.**

CIEG-352. Water Resources Engineering I, 3 credits. Includes hydrologic cycle, climatologic, meteorologic, and hydrologic data, and the effect of precipitation, water losses, and storage on surface and subsurface flow. **Prereq.: CIEG-351.**

CIEG-400. Special Topics in Civil Engineering, 3 credits. Presentation of material not normally available in regular course offerings or offering of new courses on a trial basis. Content determined by faculty member in consultation with the Department Chair.

CIEG-416. Transportation Engineering, 3 credits. Involves planning and design of highways. Students work in teams during the preparation of the required design plans, cost estimates and project reports. **Prereq.: CIEG-207; CIEG-302; CIEG-350.**

CIEG-419. Structures II, 3 credits. Theory of structural principles; determinacy and stability, approximate analysis of statically indeterminate structures; influence lines and moving loads; calculation of deflections; analysis of statically indeterminate structures using flexibility method. **Prereq.: CIEG-314.**

CIEG-420. Structures III, 3 credits. Continuation of CIEG-419 covering analysis of statically indeterminate structures, moment distribution; matrix formulation of the direct stiffness and flexibility methods; finite element techniques; introduction to nonlinear (plastics); structural stability and dynamics. **Prereq.: CIEG-419; Coreq.: CIEG-422.**

CIEG-422. Steel Design, 3 credits. Principles of structural design, loads, types of steels, tension members, columns, non-composite and composite beams, beam-columns, column base plates, and simple bolted and welded connections. The use of the AISC LRFD specification is emphasized and a comprehensive group design project is assigned. **Prereq.: CIEG-314.**

CIEG-433. Foundations, 3 credits. Based on the principles of soil mechanics, design of shallow. Using traditional and computer analysis methods. **Prereq.: CIEG-434.**

CIEG-434. Soil Mechanics Lecture, 3 credits. Provides for appreciation and understanding of the engineering properties of soils and how they relate to design and construction, including soil identification and classification. This course must be taken during the same semester as CIEG-434b, Soil Lab. Exceptions must be approved by Instructor prior to course registration. **Prereq.: CIEG-301, CIEG-311.**

CIEG-434b. Soil Mechanics Lab, 1 credit. . Experimental laboratory to accompany Soil Mechanics lecture. This course is a co-requisite of **CIEG 434, Soil Mechanics Lecture.**

CIEG-435. Reinforced Concrete, 3 credits. Discusses structural properties of concrete and steel; current building (ACI) code; theory and design of structural elements, and structural systems. **Prereq.: CIEG-314.**

CIEG-439. Senior Design I, 3 credits. This course is concerned with the planning, management , teaming and project development phase for the culminating design to be covered in CIEG 441. **Prereq: CIEG-314; CIEG-328; CIEG-350; CIEG-352; CIEG-416; CIEG-434.**

CIEG-440. Water and Wastewater Treatment, 3 credits. Advanced design of facilities for water and wastewater treatment including design ranges, regulations, economics and ethics of environmental design. **Prereq.: CIEG-328.**

CIEG-441. Senior Design II, 3 credits. The capstone design project integrates the many sub-disciplines of civil engineering into a single project. Beginning with a specification, the process passes through preliminary and detailed design culminating in a written report and verbal presentation. **Prereq.: CIEG-439.**

CIEG-442. Advanced Foundations, 3 credits. Case studies from the literature are discussed and presented. Focus is placed on behavior, which departs from traditional foundation design expectations. **Prereq.: CIEG-433.**

CIEG-445. Undergraduate Research, 3 credits. Requires a student to conduct research under the directives of an instructor. Students must seek and receive the approval of the instructor prior to enrollment in this course. The selected research topic must broaden the student's understanding of one of the five emphasis areas. **Prereq.: Approval of Instructor**

CIEG-457. Advanced Hydrology, 3 credits. Students model the hydrologic cycle and hydrologic processes to learn about and apply hydraulic models such as those hosted by the WMS (Watershed Modeling System) software, including the US Army Corps HEC-1 model and the SCS TR-20 and TR-55 models. GIS software ArcView and one of its extensions WMSHydro.avx are also used to prepare data for use in WMS models.

CIEG-462. Seminar, 1 credit. Forum for presentation of current topics of interest in civil engineering by individuals from industry, government and practice. **Co-req.: CIEG-441.**

CIEG-463. Water Resources Planning, 3 credits. Presents basic concepts in the planning of water resources development systems; analytical techniques, basic information required for planning; and examples for planning flood control, wastewater management, and water supply systems. **(Senior Status)**

CIEG-464. Engineering Project Management, 3 credits. Involves planning performing and controlling of engineering projects; introduces management roles, principles and procedures, as well as project proposal writing. **Prereq.: CIEG-350 or equivalent.** {Note: CIEG-350 Engineering Systems Analysis is now Engineering Economics.}

CIEG-465. Traffic Engineering 1, 3 credits. Involves the collection and use of traffic engineering data and introduces students to traffic operations and safety. Students use software for capacity analysis and signal optimization. Students are required to prepare reports. **Prereq.: CIEG 302; CIEG-416.**

CIEG-466. Traffic Engineering II, 3 credits. Includes city and highway traffic surveys and analyses; highway capacity analysis; and traffic control devices. **Prereq.: CIEG-465.**

Comprehensive Sciences

COMP-001. Life Sciences Lecture & Laboratory, 3 Credits. This course explores the basic concepts of the biological (life) sciences. These concepts will be presented through the examination of the principal characteristics that all living things (life forms) have in common (i.e., ecology, genetics, taxonomy, metabolism, evolution, reproduction and development, etc.). The lecture information surveys living systems on the chemical, cellular and organismal levels. The exploration is complemented by key laboratory applications and observations that will enable the students to recognize, comprehend and appreciate the complexities of biological organization that exist in nature. **Note: Students must register for the Lecture and Lab.**

COMP-002. Planetary Science Lecture & Laboratory, 3 Credits. The planetary science course involves studies of astronomy (planets, stars, the universe) and geology (the earth). In geology, the principal features of planet earth such as size, shape, composition, motions are presented. How planet earth changes as a result of internal and external forces act on it provides a topic of interest. In astronomy, emphasis is on the other planets, the solar system and other celestial bodies that exist in the universe. Laboratory investigations involve the examination of various samples, planetarium visits and field trips to area geological sites and venues where advanced technological telescopes can be used. **Note: Students must register for the Lecture and Lab.**

English

Note - Each student must complete the minimum requirement of six (6) credit hours in English as follows:

ENGL-002. Freshmen Composition I, 3 credits. Designed to develop the student's ability to express ideas clearly and effectively in writing and to read with perception and accuracy; emphasizes the power and value of written communication by reading exemplary text.

ENGL-003. Freshmen Composition II, 3 credits. Intended to increase the student's ability to write effectively, to read critically, and to present ideals logically. **Prereq.: ENGL-002.**

Mathematics

Note – It is essential that every student taking mathematics courses at Howard University take the Mathematics Placement Examination to guarantee efficient evaluation of your mathematic skills. Each student also must complete the minimum requirement of 16 credit hours as follows:

MATH-156. Calculus I, 4 credits. Limits, continuity, and the derivative and integral of functions of one variable, with applications.

MATH-157. Calculus II, 4 credits. Continuation of MATH-156, including more integration, sequences, series, Taylor's theorem, improper integrals, and L'Hospital's rule. **Prereq.: MATH 156.**

MATH-158. Calculus III, 4 credits. Continuation of MATH-157, including calculus of functions of several variables, with applications. **Prereq.: MATH-157.**

MATH-159. Differential Equations, 4 credits. Elementary techniques of solving ordinary differential equations, including slope fields, equilibrium, separation of variables, linear differential equations, homogeneous differential equations, undetermined coefficients, bifurcations, power series, Laplace transforms, systems, and numerical methods.

Prereq.: MATH-157.

MATH 164. Introduction to Numerical Analysis. 3 crs. Treats numerical integration and numerical solution of differential equations, numerical linear algebra, matrix inversion, characteristic values; error propagation; and stability. **Prereq.: CIEG-103; Coreq: MATH-159.** {Note: replaces CIEG-349 Analysis Methods in Civil Engineering}

Mechanical Engineering

MEEG 309. Materials Science, 3 credits. Correlation of the structure of metals, ceramics, and organic materials with their mechanical and physical properties, control of properties by modifying the microstructure, and stability of materials in service environments. **Prereq.: CHEM-003; PHYS 014; Coreq.: CIEG-301.** {Note: replaces CIEG-316 Material Engineering}

Physics

PHYS-013. Physics for Science and Engineering Lecture I, 3 credits. This lecture/recitation calculus-based course deals with mechanics, heat and sound. **Prereq.: MATH-156; Coreq: PHYS-023.**

PHYS-023 Physics for S&E Lab I, 1 credit. Laboratory course to accompany introductory physics course, **Coreq: PHYS-013.**

PHYS-014. Physics for Science and Engineering Lecture II, 3 credits. This lecture and recitation calculus-based course covers electricity and magnetism, light and optics. **Prereq.: PHYS-013, MATH 157; Coreq.: PHYS-023.**

PHYS-024 Physics for S&E Lab II, 1 credit. Laboratory course to accompany introductory physics course, **PHYS-023.**

ELECTIVE TABLES

Table 2. Technical Elective Courses

Course	CIEG Discipline of Focus
CIEG 466 Traffic Eng II	Transportation Engineering
* CIEG 579 Advanced Traffic Engineering	Transportation Engineering
CIEG 419 Structures II	Structural Engineering
CIEG 420 Structures III	Structural Engineering
CIEG 422 Steel Design	Structural Engineering
* CIEG 529 Intro to Structural Protection Sys.	Structural Engineering
CIEG 442 Advanced Foundations	Geotechnical Engineering
CHEM 141 Organic Chemistry	Environmental Engineering
CHEG 412 Transport Phenomena	Environmental Engineering
CIEG 440 Water and Wastewater Treatment	Environmental Engineering
* CIEG 511 Aquatic Chemistry	Environmental Engineering
* CIEG 557 Advanced Hydrology	Water Resources Engineering
* CIEG 556 Hydraulic Project Research	Water Resources Engineering
CIEG 464 Eng Project Management	General
CIEG 400 Special Topics in Civil Engineering	General
CIEG 445 Undergraduate Research	General
MEEG 205 Thermodynamics	General
Students may choose only one of the following courses as a technical elective.	
* SOCI 219 Advanced Statistics I	General
* POLS 279 Survey Research Methods	General

*:indicates a graduate course that students can complete as a technical elective

Table 3. African-American Elective Courses

AFRO-005	Intro to Afro-American Studies I
AFRO-006	Intro to Afro-American Studies II
HIST-005	Intro to the Black Diaspora I
HIST-006	Intro to the Black Diaspora II
MUTP-100	Blacks in Arts
ENGL-054	African-American Literature to 1940
ENGL-055	African-American Literature from 1940 to Present
AFST-101	African World
FASH-102	African-American Dress
ARTH-193	Black Body Dress and Culture
POLS-006	Pan-Africanism

Table 4. Humanities Elective Courses

CLAS-016	Literature of the Ancient World
CLAS-101	Greek Literature
CLAS-102	Roman Literature
CLAS-108	Greek Drama
CLAS-109	Classical Mythology
CLAS-113	Women in the Ancient World
ENGL-054	African- American Literature I
ENGL-055	African-American Literature II
FREN-100	Francophone Literature in English
RUSS-100	Russian Short Stories
ENGL-014	Intro to Humanities I
SPAN-100	Hispanic Literature in English
GERM-107	Women in Literature
AFST-111	African Systems of Thought
AFST-701	African World-Writing
CLAS-030	Vocabulary Building
CLAS-015	Humanities II
ENGL-113	College Grammar
ENGL-225	Modern Caribbean Literature
ENGL-110	Language Foundation
ENGL-192	Creative Writing Workshop
CLAS-001	Elementary Latin
GERM-100	Individual and Society
HIST-170	Climate, People, & Environment
CLAS-103	Classical Art
CLAS-011	Satire and Comedy in the Ancient World
FASH-102	African-American Dress
MUSC-100	Introduction to Music
MUTP-100	Blacks in Arts
ARTH-161	Art Appreciation
ARTH-193	Black Body Dress and Culture
THFD-010	Introduction to the Theater
PHIL-051	Principle of Reasoning
PHIL-055	Introduction to Philosophy

Table 5. Social Sciences Elective Courses

CLAS-104	Greek Civilization
CLAS-105	Roman Civilization
HIST-001	Intro to Study of Civilization I
HIST-002	Intro to Study of Civilization II
HIST-005	Intro to Black Diaspora I
HIST-006	Intro to Black Diaspora II
HIST-009	US History to 1877
HIST-010	US History since 1877
HIST-101	World Geography
HIST-102	Economic Geography
AFRO-005	Afro-American Studies I
AFRO-006	Afro-American Studies II
AFST-101	African World
HIST-140	History of the Caribbean
HIST-176	Afro-American to 1877
HIST-177	Afro-American Since 1877
HIST-030	Intro to African History I
HIST-031	Intro to African History II
PSYC-080	Intro to Psychology
PSYC-125	General Social Psychology
SOCI 180	Sociology of Afro-Americans
SOCI-181	Sociology of Poverty
SOCI-001	Intro to Sociology
SOCI-020	Intro to Social Psychology
ANTH-110	Intro to Cultural Anthropology
ANTH-120	Intro to Biological Anthropology
POLS-001	Intro to Black Politics
POLS-006	Pan-Africanism
ECON-001	Principles of Economics I
ECON-002	Principles of Economics II
ECON-180	Statistics-Bus & Economics

Table 6. Free Elective Courses

This list is intended to guide students seeking a recommendation for their free elective. Students wishing to register for any of the following courses should check with the instructor to confirm the prerequisites and any other requirements for the course. This list is not exhaustive; students may submit additional courses to their advisor for approval.

Course	Cr.	School/College	Prerequisite(s)
HUCO 410 Negotiation and Conflict	3	Communications	none
ACCT 343 Ethics, Values and Governance	3	Business	None
INBU 300 Principles of International	3	Business	ECON 001, ECON 002, and junior standing
MGMT 301 Management and Org. Behavior	3	Business	ECON 001, ECON 002, and junior standing
MGMT 352 Entrepreneurship	3	Business	Check with instructor
MKTG 301 Principles of Marketing	3	Business	ECON 001, ECON 002, and junior standing
BCOM 320 Business Communications	3	Business	ENGL 002 and ENGL 003
BLAW 305 Business Law	3	Business	Sophomore standing
MEEG 205 Thermodynamics	3	CEACS	PHYS-014, MATH-158
EECE 310 Principles of Electronics	3	CEACS	PHYS-014, MATH-159
ARCH-651 Principle of Urban Design	3	CEACS	Permission of instructor
SYCS 165 Elementary Computation	3	CEACS	none
MATH 180 Introduction to Linear Algebra	3	Arts & Sciences	MATH-157
MATH 181 Discrete Structures	3	Arts & Sciences	MATH-157
ECON 188 Econ. of Black Community Dev.	3	Arts & Sciences	ECON 001 and ECON 002
ECON 190 Public Finance	3	Arts & Sciences	ECON 001
ECON 194 Theory of Economic	3	Arts & Sciences	ECON 001 and ECON 002
ECON 199 Introduction to Urban Economics	3	Arts & Sciences	ECON 001 and ECON 002
POLS 149 Introduction to Public Policy	3	Arts & Sciences	none
POLS 165 Urban Political Economy	3	Arts & Sciences	none
POLS 183 Race and Public Policy	3	Arts & Sciences	Permission of instructor
PHIL 147 Ethics and Public Policy	3	Arts & Sciences	none
PHIL 148 Environmental Ethics	3	Arts & Sciences	none
PHIL 158 Business and Professional Ethics	3	Arts & Sciences	none
SOCI 130 Principles of Demography	3	Arts & Sciences	none
Students desiring a free elective in a language may check with the instructors of the following courses to determine their readiness and ability to register for the course. Students must already be familiar with the fundamentals of the language.			
059-011 Business German	3	Arts & Sciences	Check with instructor
060-010 Business Russian	3	Arts & Sciences	Check with instructor
058-078 Business Spanish	3	Arts & Sciences	Check with instructor
062-078 Business French	3	Arts & Sciences	Check with instructor