Electrical Engineering

Undergraduate Handbook

Department of Electrical Engineering and Computer Science

Howard University

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CHAIR'S WELCOME NOTE

Welcome to the Department of Electrical Engineering and Computer Science (EECS) at Howard University. The department offers accredited undergraduate electrical engineering, computer engineering, and computer science programs.

The EECS at Howard University is a dynamic unit of the College of Engineering and Architecture (CEA). Over the years the EECS has established a reputation for excellence in teaching, research, and service to the Howard local, national, and international communities. For many years, the department has been one of the large producers of African-American and minorities engineers at the bachelor, master's, and Ph.D. level. The department has some of the most highly regarded centers and laboratories where exciting research in innovative technology continues to attract the local and international students from all over the world. Also, our graduates are sought after by industry and government agencies. Many of our graduates have been accepted in top graduate programs in the nation. A large number of our graduates have moved to leadership positions and academy all over the world.

The department continues to attract and hire outstanding faculty members. We put a special emphasis in our undergraduate programs: We are continually improving our labs, curriculum and advising programs; establishing new mentoring and research programs for undergraduates; and working on developing better relationship with local and national industry.

This handbook for undergraduate electrical engineering (EE) program contains a listing of courses designed for a four-year curriculum and a few other resources that you should find very useful. This handbook does not provide a complete guide to information you need for your day-to-day stay here at Howard. You should consult other university and college publications such as **Student Handbook, and Undergraduate Catalog** for detailed information. You will be assisted by a program academic advisor offered by the Office of Student Success for your course registration. Therefore, you are encouraged to visit the academic advisor as often as possible, at least once per semester for academic matters relating to your courses and career objectives.

You should feel free to visit the EECS Office in Room 1016, L.K. Downing Building and the CEA Office of Student Success in Room 1114, L.K. Downing Building and acquaint yourself with other academic and non-academic resources that are available in the College and the University.

The EECS faculty and staff are committed to continuous improvements of our program. We encourage your comments on all aspects of our program. We are particularly interested in comments regarding program educational objectives, student outcomes and the curriculum.

Again, we welcome you to the EE program of the EECS and we wish success.

Charles Kim, Ph.D.
Interim Chair and Professor

I. ELECTRICAL ENGINEERING PROGRAM

A INTRODUCTION

Electrical Engineering (EE) is a dynamic, impactful, and rewarding profession that plays a central role in modern technology and society. The EE program prepares students with strong foundations in mathematics, science, engineering design, and hands-on problem solving, while exposing them to key areas such as circuits, electronics, semiconductor technology, electromagnetics, remote sensing, digital systems, communications, signal processing, power and energy systems, control, and embedded systems. These skills open career opportunities in telecommunications, aerospace, energy, computing, electronics, healthcare, defense, transportation, government, and emerging fields such as artificial intelligence, robotics, smart grids, renewable energy, cybersecurity, Internet of Things, and space and non-terrestrial communication systems.

Through the program, students develop the technical knowledge, creativity, teamwork, communication skills, and ethical responsibility needed to become successful engineers, innovators, and leaders. Many graduates pursue post baccalaureate studies for advanced degrees in EE or related fields, and many apply their technical expertise to engineering professions as well as to business, law, or medicine.

The EE program is fully accredited by ABET. Courses are taught to meet the requirements of ABET for the program. The curriculum for the program is design-based and fully integrated with basic science and math, liberal arts and humanities, and electrical engineering core courses. Depth in EE program is covered in the upper-level courses and EE elective courses. Foundation courses are covered at sophomore and junior levels.

B MISSION AND EDUCATIONAL OBJECTIVES

EECS Mission

The mission of the Department of Electrical Engineering and Computer Science is that the department strives to:

1. Give students strong background in the fundamentals of computer science, computer engineering, and electrical engineering through high-impact scholarship and research;
2. Expand and diversify the pool of qualified individuals in the engineering profession and to advance knowledge in computer science by providing high quality instruction and conducting research that addresses technical challenges and societal problems;
3. Provide service to the university, the profession, the community, and society while dedicated to promotion of excellence among students, faculty and staff.

EE Program Educational Objectives

- **Objective 1:** Graduates of the Electrical Engineering Program achieve successful careers in Electrical Engineering or other fields that require technical and/or professional skills and knowledge.
- **Objective 2:** Graduates of the Electrical Engineering Program pursue continuous professional development, including advanced study and/or research in technical or professional fields.

- **Objective 3:** Graduates of the Electrical Engineering Program demonstrate active engagement and leadership within professional/community activities, with a special emphasis on African-American and other underrepresented communities.

EE Program Student Outcomes

Our EE program demonstrates that our EE graduates have:

(1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

(2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

(3) An ability to communicate effectively with a range of audiences.

(4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

(5) An ability to function effectively on a team whose members together provide leadership, create a collaborative environment, establish goals, plan tasks, and meet objectives.

(6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

(7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

These program outcomes, (1) to (7), are consistent with the "Criteria for accrediting engineering programs 2025-2026" Reference Manual.

C Academic Policies and Procedures

Please review the Howard University Academic Policies and Procedures, which are managed by the CEA Office of Student Success and available on the official CEA Academic Policies and Procedures page.

II. Bachelor of Science in Electrical Engineering (EE) Program

A CURRICULUM FOR EE PROGRAM

The Electrical Engineering curriculum contains a broad core of topics, which underlie the practice of engineering and provide a balanced curriculum through integration of studies in mathematics and basic science, engineering science and engineering design, and general studies that meet or exceed expectations of the ABET criterion 5 including the requirement that the curriculum culminate in a major design experience. A total of 120 semester credit hours are required and distributed as follows:

Undergraduate EE Curriculum (Distribution of Hours)

Concentration	**Number of Credit Hours**
Math, Science, Liberal Arts, Computer Science Core Courses	39
Electrical Engineering Core	48
Electrical Engineering Electives	18
Math/Science Elective	3
Social Science and Humanities Electives	9
African American Studies Electives	3
Total	**120**

University Requirements
University-Wide Requirements for graduation include a minimum GPA: 2.0 for all undergraduate coursework. In addition, students must complete last 30 credits at Howard University. In addition, all students must satisfy the Howard University General Education: Essential Learning Outcomes.

Students must complete courses covering all seven outcome areas. These can overlap with other requirements. Note: ELO courses are tagged in Bison Hub under the course description

Howard University General Education: Essential Learning Outcomes

HU ELOs	EE
ELO 1: U.S. and Global African Diasporic Developments	African American Elective
ELO 2: Human Cultures and Creative Expression	Humanities Electives
ELO 3: The Physical and Natural World	Science Electives
ELO 4: Intellectual and Practical Skills	EE Core and Tech Electives
ELO 5: Social Responsibility and Political Institutions	Non-Technical Electives - Humanities/Social Science
ELO 6: Leadership and Applied Learning	EECE 401 Senior Project I, EECE 404 Senior Project II
ELO 7: Comprehensive Wellness Practices	EGPP101

B CURRICULUM DETAILS FOR EE PROGRAM

Math, Science, Liberal Arts, Computer Science Core Courses (Total 39 credit hours)

CHEM-003	General Chemistry Lecture	4
CHEM-005	Chemistry Lab.	1
ENGW-104 (102)	Writing Literacy & Discourse	3
ENGW-105 (103)	Reflective Writing Portfolio	3
MATH-156	Calculus I	4
MATH-157	Calculus II	4
MATH-158	Calculus III	4
MATH-159	Differential Equations	4
PHYS-013	Physics for Science & Engineers I	3
PHYS-014	Physics for Science & Engineers II	3
PHYS-023	Physics for Science & Engineers I-Lab.	1
PHYS-024	Physics for Science & Engineers II - Lab.	1
CSCI-135	Computer Science I	4

Electrical Engineering Core Courses (Total 48 credit hours)

EGPP-101	Intro to Engineering	2
EECE-102	Introduction to Electrical and Computer Engineering	1
EECE-160	Engineering Mathematics	4
EECE-203	Fund Circuit Theory	4
EECE-209	Fund Circuit Theory (Lab)	1
EECE-212	Fund Digital Systems	4
EECE-218	Fund Digital Systems Lab	1
EECE-260	Engineering Programming and Applications	3
EECE-305	Fund Electromagnetics	4
EECE-306	Fund Electromagnetics (Lab)	1
EECE-309	Fund Electronics and SS	4
EECE-312	Fund Electronics and SS (Lab)	1
EECE-331	Probability and Statistics for Engineering Applications	3
EECE-325	Fund Energy Systems	4
EECE-326	Fund Energy Systems (Lab)	1
EECE-333	Fund Signals & Systems	4
EECE-401	Senior Design I	3
EECE-404	Senior Design II	3

Elective Courses

I. Electrical Engineering Elective Courses (Total 18 credit hours)

Six (6) 3-credit courses are required. Combinations of 1-credit or 2-credit courses do not satisfy the Electrical Engineering Elective. Only VIP courses with distinct course numbers are exempt from this rule. Most EECE-4xx and CSCI-4xx courses are accepted; EGPP-4xx courses are NOT accepted. Minimum 6 credit hours are to be taken from a concentration area. The list is not comprehensive or exhaustive; these courses have been historically offered but may not be available regularly. Please talk to your academic advisor before making a selection.

Note: *Do NOT take* ***EECE-310 Principles of Electronics*** *as an EE elective. EECE-310 is intended for non-EE majors and does not count toward the EE degree requirements.*

Digital Systems and Microcomputer Area

EECE-406	Advanced Digital Systems Design	3
EECE-410	Intro to Computer Networks	3
EECE-412	Advanced Digital Systems Design Laboratory	1
EECE-416	Microcomputer Design	3
EECE-417	Computer Architecture	3
EECE-446	ASIC Design	3
EECE-456	Embedded System Design Lab	3

Signals and Communication Area

EECE-453	Communication Theory	3
EECE-454	Communication Electronics	3
EECE-459	Communication Theory Lab	1
EECE-460	Wireless Communication	3
EECE-479	Cybersecurity Network CPS/IoT	3
EECE-487	Telecommunications	3
EECE-495	Signal Processing	3

Energy and Power Control Systems Area

EECE-408	Linear Control Systems	3
EECE-418	Power Electronics	3
EECE-419	Motor Dynamics and Drives	3
EECE-421	Power System Analysis	3
EECE-422	Power Communication and Control	3

Physical Electronics and Material Sciences Area

EECE-420	Intro to VLSI Design	3
EECE-461	Solid-State Electronics	3
EECE-462	Solid State Electronics II	3
EECE-463	Digital Electronics	3
EECE-465	Physical Electronics	3
EECE-471	Design of Integrated Circuits	3
EECE-477	Design of Integrated Circuits Lab	3
EECE-481	Advanced Integrated Circuit Design	3
EECE-482	Integrated Circuit Validation	3

Electromagnetics and Microwave Area

EECE-443	Introduction to Microwaves	3
EECE-444	Antenna Theory and Practices	3
EECE-466	Advanced Electromagnetics Theory	3

Faculty-Student Team Project (VIP)

EECE-101/ EECE-201/ EECE-302	Faculty-Student Team Project (VIP) course (each 1 cr; take 1 course per semester); 3 VIP courses counted as a 3-credit EE/CpE elective course	3

Partial List of CSCI-4xx Courses (also accepted as EE Electives)

CSCI-453	Intro to Cybersecurity	3
CSCI-473	Applied Data Science	3
CSCI-475	Intro to Machine Learning	3
CSCI-476	Intro to AI	3
CSCI-498	Special Topics: Robotics Programming	3

II. Math/Science Elective Courses (3 credit hours required)

The list is not comprehensive or exhaustive; these courses have been historically offered but may not be available regularly. Please talk to your academic advisor before making a selection.

BIOL-101	General Biology I Lecture/Lab	3
BIOL-102	General Biology II Lecture/Lab	3
COMP-001	Life Sciences Lecture/Lab	3
COMP-002	Planetary Sciences Lecture/Lab	3
COMP-003	Physical Sciences Lecture/Lab	3
MATH-014	Intro to Data Science	3
MATH-026	Applied Calculus	3
MATH-009	Introduction Statistics	3
PHYS-001	General Physics Lecture/Lab	3
PHYS-002	General Physics Lecture/Lab	3
PHYS-010	General Astronomy I	3
PSYC-050	Introduction to Psychology (not for Psych majors)	3

III. Social Science Electives (ECON-001 required; choose 3 additional credit hours from list)

Social Science Electives (per COAS Divisional Studies B and C)

The list is not comprehensive or exhaustive; these courses have been historically offered but may not be available regularly. Please talk to your academic advisor before making a selection.

AFRO-005	Introduction to Afro-American Studies I	3
AFRO-006	Afro-American Studies II	3
AFRO-122	Education in Black America	3
AFRO-133	19th Century Black Social-Political	3
AFRO-186	Black Women in American II	3
AFST-101	Intro to Contemporary Africa	3
AFST-106	HIV/AIDS in Africa	3
ANTH-110	Intro to Cultural Anthropology	3
CLAS-115	Slavery in the Ancient World	3
ECON-001	Principles of Economics I (required)	3
ECON-002	Principles of Economics II	3
ECON-199	Intro to Urban Economics	3
HIST-003	Intro to History	3
HIST-005	Introduction to Black Diaspora I	3
HIST-006	Intro to Black Diaspora II	3
HIST-009	U.S. History to 1877	3
HIST-010	U.S. History since 1877	3
HIST-030	Intro to African History I	3
HIST-031	Intro to African History II	3
HIST-051	Intro to European History II	3
HIST-054	Intro to England	3
HIST-060	Intro to East Asian Civilization I	3
HIST-061	Intro to East Asian Civilization II	3
HIST-101	World Geography	3
HIST-106	Environmental Conservation	3
HIST-150	Intro to European History I	3
POLS-001	Introduction to Political Science	3
POLS-003	Intro to Comparative Politics	3
POLS-010	National Government of the U.S.	3
POLS-011	State and Local Government	3
SOCI-001	Introduction to Sociology	3
SOCI-174	Police, Law and Society	3
SOCI-198	Negro in America	3

IV. Humanities Elective Courses (3 hours from the list)
Humanities Electives (per COAS Divisional Studies A)

The list is not comprehensive or exhaustive; these courses have been historically offered but may not be available regularly. Please talk to your academic advisor before making a selection.

ARTH-161	Art Appreciation	3
ARTH-164	Survey of Visual Art	3
CLAS-014	Intro to Humanities I	3
CLAS-016	Ideas in Antiquity	3
CLAS-050	Ancient Egypt and Near East	3
CLAS-103	Classical Art	3
ENGL-014	Intro to Humanities I	3
ENGL-015	Intro to Humanities II	3
ENGL-054	Afro-Am Literature to 1940	3
ENGL-055	Afro-Am Literature since 1940	3
FASH-102	African American Dress	3
FREN-014	Intro to Humanities I	3
FREN-106	African Films	3
HUMA-107	Women in Literature	3
MUSC-100	Introduction to Music	3
PHIL-055	Intro to Philosophy	3
RUSS-101	Literature in Revolution	3
RUSS-103	Love and Hate in Literature	3
SPAN-014	Intro to Humanities I	3
THFD-010	Introduction to the Theatre	3
THFD-080	Play Analysis	3

V. African American Studies Elective Courses (3 hours required)

The list is not comprehensive or exhaustive; these courses have been historically offered but may not be available regularly. Please talk to your academic advisor before making a selection.

AFRO-005	Introduction to Afro-American Studies I	3
AFST-101	African World: Intro to Contemporary Africa	3
ARTH-193	Black Body Dress & Culture	3
ENGL-054	Afro-American Literature to 1940	3
FASH-102	African-American Dress	3
HIST-005	Introduction to Black Diaspora I	3
MUTP-100	Blacks in the Arts	3
POLS-006	Pan Africanism	3

C ELECTRICAL ENGINEERING 4-Year Degree Plan with Pre/Co-Requisites

Most core courses are mainly offered only once per academic year. If you do not meet the minimum grade requirement, you must wait until the following year to retake the course.

Freshman Semester 1 (15 Credits)

Course	Crs	Prerequisite	Co-requisite
MATH-156 Calculus I	4	Pre-Calc	
EGPP-101 Intro. to Engineering	2		
CSCI-135 Computer Science I	4		
CHEM-003 General Chemistry I Lecture	4		CHEM-005
CHEM-005 General Chemistry I Lab	1		

Freshman Semester 2 (15 Credits)

Course	Crs	Prerequisite	Co-requisite
MATH-157 Calculus II	4	MATH-156	
EECE-102 Intro. to EE and CpE	1		
EECE-260 Engineering Programming and Appl	3		
PHYS-013 Physics I (Sci. and Engr.)[1]	3	MATH-156	MATH-156, PHYS-023
PHYS-023 Physics I Lab (Sci. and Engr.)	1		
ENGW-104 (102) Writing Lit & Disc	3		

Sophomore Semester 1 (17 Credits)

Course	Crs	Prerequisite	Co-requisite
MATH-158 Calculus III	4	MATH-157	
PHYS-014 Physics II (Sci. and Engr.)[2]	3	PHYS-013, MATH-157	MATH-157, PHYS-024
PHYS-024 Physics II Lab (Sci. and Engr.)	1		
EECE-212 Fundamentals of Dig. Systems	4		EECE-218
EECE-218 Fundamentals of Dig. Systems Lab	1		
MATH-159 Differential Equations	4	MATH-157	

Sophomore Semester 2 (15 Credits)

Course	Crs	Prerequisite	Co-requisite
EECE-160 Engineering Mathematics	4	MATH-158	
EECE-203 Fundamentals of Circuit Theory	4	PHYS-014, PHYS-024	EECE-209
EECE-209 Fundamentals of Circuit Theory Lab	1	PHYS-014, PHYS-024	EECE-203
ENGW-105 (103) Reflective Writing Portfolio	3	ENGW-104 (102)	
Social Science Elective	3		

[1]MATH 156 may be taken as either a prerequisite or a corequisite for PHYS 013.
[2]MATH 157 may be taken as either a prerequisite or a corequisite for PHYS 014.

Junior Semester 1 (16 Credits)

Course	Crs	Prerequisite	Co-requisite
EECE-305 Fundamentals of Electromagnetics	4	MATH-158	EECE-306
EECE-306 Fundamentals of Electromagnetics Lab	1		EECE-305
EECE-309 Fund of Electronics and SS Devices	4	EECE-203	EECE-312
EECE-312 Fund of Electronics and SS Devices Lab	1	EECE 209	EECE 309
EECE-331 Probability and Statistics for Eng. Appl	3	MATH-157	
Humanities Elective	3		

Junior Semester 2 (15 Credits)

Course	Crs	Prerequisite	Co-requisite
EECE-333 Fundamentals of Signals and Systems	4	MATH-158	
EECE-325 Fundamentals of Energy Systems	4	EECE-203	EECE-326
EECE-326 Fundamentals of Energy Systems Lab	1		EECE-325
African American Studies Elective	3		
Math/Science Elective	3		

Senior Semester 1 (12 Credits)

Course	Crs	Prerequisite	Co-requisite
EE Elective	3		
EE Elective	3		
EE Elective	3		
EECE-401 Senior Design I	3	Senior Standing with Instructor Approval	

Senior Semester 2 (15 Credits)

Course	Crs	Prerequisite	Co-requisite
EE Elective	3		
EE/CpE Elective	3		
EE/CpE Elective	3		
EECE-404 Senior Design II	3	EECE-401	
ECON-001 Principles of Economics	3		

III. EE COURSE DESCRIPTIONS

The following course description will also appear on the department web site and the course catalogue.

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 opportunity for students to complete engineering design projects.
Course Offering: FALL.

EECE-101/201/302 VIP: Faculty-Student Team Project **1 Credit**
The Vertically-Integrated Projects (VIP) Program operates in a research and development context. Undergraduate students that join VIP teams earn academic credit for their participation in design/discovery efforts in doing faculty-student team project. The enrolled students join and participate in their desired projects advised by respective faculty members. The instructor of the course acts as the coordinator of the VIP course for the entire VIP projects given by faculty advisors. Accumulation of 3 VIP courses with passing grade would satisfy one (1) EE/CpE Elective course requirement in the respective curriculum. Only one VIP course may be taken for a given semester.
Course Offering: FALL and SPRING.

EECE-102 Introduction to Electrical & Computer Engineering **1 Credit**
Continuation of EGPP-101 as related to the electrical engineering profession. Organized in five (5) Blocks: Descriptive, Environment, Technical, Practical (Hands on), and Projects, students are introduced to various engineering issues related to the profession of electrical engineering. Historical perspectives and Electrical Engineering Education / Profession and Design are reviewed. Ethics, social / environmental / cultural / religion issues facing electrical engineers in a global work environment are discussed. An overview of electrical engineering discipline and five major classifications of electrical systems in communication, computer, control, power, and signal processing is presented. Technical aspects and safety considerations of a typical electrical engineering laboratory are introduced. A capstone term project requires assembling an electrical system (e.g., a robot kit) and its study and presentation from a system point of view.
Course Offering: SPRING.

EECE-160 Engineering Mathematics **4 Credits**
Course introduction; history and importance of engineering Mathematics, trigonometry in engineering, 2-D vectors in engineering, complex numbers in engineering, 3-D vectors in engineering, systems of equations in engineering, application of derivatives in engineering, application of integrals in engineering, solving differential equation, applications of differential equations in engineering, Laplace transforms and applications, Interdisciplinary Applications.
Prereqs.: MATH-158. Course Offering: SPRING

EECE-203 Fundamental Circuit Theory **4 Credits**
Understanding of basic circuit theory, circuit theorems, dc, ac circuits, magnetic circuits, transients, Laplace and Fourier transforms, Fourier series, electric devices, 2-port network, basic filters and op-amps. Prereqs.: PHYS-014, PHYS-024.
Coreq.: EECE-209. Course Offering: SPRING.

EECE-209 Fundamental Circuit Theory Laboratory **1 Credit**
Understanding of hands-on labs associated basic circuit theory, circuit theorems, dc, ac circuits, operational amplifiers (op-amps), electric devices network, basic filters and op-amps.
Prereqs.: PHYS-014, PHYS-024. Coreq.: EECE-203. Course Offering: SPRING.

EECE-212 Fundamental Digital Systems **4 Credits**
Introduction to hardware building blocks used in digital computers and systems. Introduces number systems (including binary, octal and hexadecimal), Boolean algebra, two-level/multilevel logic minimization/simplification using K-Maps and Quine-McCluskey Methods, combinational logic circuit design and implementation with available SSI, MSI, and programmable logic devices (PAL, PLA, multiplexers, encoders, ROMS). Practical considerations such as Hazard and glitches are treated. Basics of sequential logic design including latches, flip-flops, registers, counters, finite state machines design, minimization, and implementation are presented.
Coreq: EECE-218. Course Offering: FALL.

EECE-218 Fundamental Digital Systems Laboratory **1 Credit**
Laboratory experiments and (mini) projects in design and implementation of simplex to moderately complex combinational and sequential logic circuits provide a practical understanding of concepts covered in EECE-212. Project(s) introduce students to design with programmable logic devices and logic design/simulation software such as Electronics Workbench.
Coreq: EECE-212. Course Offering: FALL.

EECE-260 Engineering Programming and Application **3 Credits**
The course covers both procedural programming and object-oriented programming in Python with applications to mathematics, numerical calculus, probability and statistics, physics, and differential calculus. It also covers basic C++ programming.
Course Offering: Spring.

EECE-305 Fundamental Electromagnetics **4 Credits**
Electric fields, flux and potential; Coulomb's Poisson's and Gauss's laws; permitivity and conductivity, magnetostatics, magnetic materials, magnetic materials and forces, Biot-Savart's law and time varying fields, Maxwell's equations in integral and differential forms, time-domain analysis of waves. Application of electromagnetic theory to Transmission lines.
Prereqs. MATH-158. Coreq: EECE-306. Course Offering: FALL.

EECE-306 Fundamental Electromagnetics Laboratory **1 Credit**
Fundamental applications of electromagnetic theory and developing modeling and simulation abilities. Topics include vector calculation and coulomb's law; vector representations in different coordinate systems; numerical calculation of electrostatic fields; Gauss's law and electrostatic potential; electrostatic boundary value problems; Poisson solver in MATLAB; cross product and Biot-Savart's law; symbolic programming in MATLAB; visualization of magnetic flux and calculation of magnetic force; fundamentals of dynamic electromagnetic fields; 3D visualization of electromagnetic wave; and solution of wave equation.
Coreq.: EECE-305. Course Offering: FALL.

EECE-309 Fundamental Electronics and Solid States **4 Credits**
Understanding of basic semiconductors devices, characteristics, switching and basic amplifiers, operational amplifiers, frequency response, filters, wave generation, introduction to power electronics,

team work.
Prereq.: EECE-203, Coreq: EECE-312. Course Offering: FALL.

EECE-312 Fundamental Electronics and Solid States Laboratory 1 Credit
Understanding of basic semiconductors devices, characteristics, switching and basic amplifiers, operational amplifiers, frequency response, filters, wave generation, introduction to power electronics, team work.
Prereqs.: EECE-209. Coreq: EECE-309. Course Offering: FALL.

EECE-325 Fundamentals of Energy Systems 4 Credits
This course focuses on the fundamentals of energy systems centered around electric power generation. Starting with the traditional system of large, central power stations connected to their customers by hundreds or thousands of miles of transmission lines, this course covers distributed, renewable, cleaner, smaller generation systems located closer to their loads. In that regard, while other generation sources such as Biomass and Fuel Cells are covered, wind power generation systems and photovoltaic (PV) power generation systems are highlighted in the course.
Prereq.: EECE-203, Coreq: EECE-326. Course Offering: SPRING.

EECE-326 Fundamentals of Energy Systems Laboratory 1 Credit
This course focuses on the laboratory experiments of fundamentals of energy systems dealing with poly-phase power measurements, synchronous machines, transmission line, renewable electricity systems of induction motor/generator. Also emphasized is renewable energy system modeling tools and system development using the modeling tools.
Coreq.: EECE-325. Course Offering: SPRING.

EECE-331 Probability and Statistics for Engineering Applications 3 Credits
Applications of signals and systems control, to communications and signal processing, (digital filter, narrow-band signals, modulation/demodulation, multiplexing: control systems, feedback and stability), computer exercises. Applied probability and statistics, sample spaces and events, measure theory, experiments, trials, distributions (such as Poisson, Bionomial, and normal), random variables (continuous and discrete), law of large numbers, Chebyshev's inequality, estimation, reliability and quality. Designing with tolerance, applications of probability and statistics in engineering design.
Prereq.: MATH-157. Course Offering: FALL.

EECE-333 Fundamental Signals and Systems 4 Credits
Design-based course, introduces comprehensive treatment of basic signal theory in time and frequency domains. Discrete and continuous time cases are treated simultaneously, covers concepts of signals and systems, convolution of difference and differential systems, block diagrams, state-space realizations and solution, matrix theory, Fourier series, transform techniques (Fourier, FFT, Z and Laplace), frequency response and stability. Exercises include traditional homework problems, computer applications such as MATLAB, C and SIGSYS and hardware design (laboratory generation of various signals and application to systems response) and design projects (Demonstration is required).
Prereqs: MATH-158. Course Offering: SPRING.

EECE-401 Senior Design I 3 Credits
Fundamentals of design principles, and engineering applications, design methodologies with emphasis on synthesis and evaluation, design process, reliability, the impact of engineering economy,

report writing, ethics and alternative solutions will be discussed.
Prereqs.: Senior Standing with Instructor Approval. Course Offering: FALL. NOTE: At the conclusion of this course, students must identify a topic and an advisor for their Thesis Design Project. The project must be approved by the advisor; this is a prerequisite for EECE-404.

EECE-404 Senior Design II **3 Credits**
To enhance knowledge of engineering design principles to solve real world problems, project planning, analysis, simulation and presentation, economic impact, ethics synthesis. Design areas are selected from solid state electronics, digital systems, communications (signal processing), power/energy systems and controls, power electronics, antennas and microwave and others. Oral presentation (with poster session) as well as written report required.
Prereq.: EECE-401. Course Offering: SPRING. NOTE: The entire semester will be devoted to the design and implementation of the Senior Thesis Project selected by students and approved by his/her advisor at the conclusion of EECE-401. It is the prerequisite of this course that students identify a topic and an advisor for their Senior Thesis Design Project at the conclusion of EECE-401.

EECE-406 Advanced Digital Systems Design **3 Credits**
This course provides an introduction to the design of dedicated hardware digital systems using VHDL hardware description language (HDL) and associated Xilinx computer-aided design (CAD) tools. Students will gain hands-on experience by working with Xilinx FPGA computer-aided design (CAD) tools to describe, synthesize, implement and test designs on their FPGA boards. List of topics covered: Overview of VHDL, VHDL Essentials, Concurrent Signal Assignment, Sequential Statements, Finite State Machines, Register Transfer Methodology, etc.
Prereq.: EECE-212. Coreq.: EECE-412. Course Offering: FALL.

EECE-408 Linear Control Systems **3 Credits**
Analysis of time and frequency response of closed loop systems, block diagrams, signal flow graphs, Mason gain, Routh-Hurwitz and Nyquist criteria for stability, root-locus method and system specifications, compensators, state variable methods, introduction to digital control.
Prereq.: EECE-333. Course Offering: FALL.

EECE-410 Intro to Computer Networks **3 Credits**
List of topics covered: Computer Networks and the Internet, Application Layer, Transport Layer, The Network Layer, The Data Link Layer, and The Physical Layer. More specifically, An Introduction to Networking, Networking Standards and the OSI Model, Transmission Basics and Networking Media, Introduction to TCP/IP Protocols.
Course Offering: FALL and SPRING.

EECE-412 Advanced Digital Systems Design Laboratory **1 Credit**
This lab course gives instructions on design, test, and verification, using VHSIC Hardware Description Language (VHDL) and associated CAD tools. Brief list of topics to be covered: VDHL syntax and good practices, VHDL behavioral and structural descriptions, Finite State Machines (FSM)/Data Paths/Control Paths, etc.
Coreq.: EECE-406. Course Offering: FALL.

EECE-416 Microcomputer Design **3 Credits**
Examines microprocessors, support architectures, and hardware/software. Microprocessors' soft-

ware model and programming, assembly language programming, microprocessor applications, microprocessor based systems, and microcomputers. Projects will be used to introduce microprocessor applications.
Prereq.: EECE-212. Course Offering: FALL.

EECE-417 Computer Architecture **3 Credits**
Computer Abstractions and Technology, Instructions: Language of the Computer, Arithmetic for Computers, The RISC-V Processor, Large and Fast: Exploiting Memory Hierarchy, Parallel Processors from Client to Cloud
Prereq.: EECE-212. Course Offering: SPRING.

EECE-418 Power Electronics **3 Credits**
Characteristics of power electronics devices, converters, ac-dc, dc-dc, ac-ac, dc-ac, power supplies, cycloconverters, design projects, computer simulations.
Prereqs.: EECE-203. Course Offering: FALL.

EECE-419 Motor Dynamics and Drives **3 Credits**
D.C. and A.C. drives, electric motors, microcomputer control, protective relaying, projects, computer simulations.
Prereqs.: EECE-325, and EECE-418. Course Offering: FALL

EECE-420 Introduction to VLSI Design **3 Credits**
CMOS technology and theory; CMOS circuit and digital logic design; layout rules and techniques; circuit characterization and performance estimation; CMOS subsystem design; VLSI systems design methods; VLSI CAD tools; laboratory experience in custom VLSI chip design on workstations using concepts in cell hierarchy; final project involving specification, design and evaluation of a VLSI chip or VLSI CAD program. Written report and oral presentation of the final project are required.
Prereqs.: EECE-212, and EECE-309. Course Offering: FALL

EECE-423 VLSI Lab **1 Credits**
Chip fabrication is highly expensive and time-consuming. Because of this, designers rely on simulation tools to explore design spaces and verify layouts before manufacturing. While simulators operate across multiple levels of abstraction—from physical processes to system architecture—this lab focuses specifically on circuit simulation using Synopsys HSPICE. Key topics covered include *HSPICE Fundamentals*: Learn the core basics and commands of the software. *Gate Characterization*: Analyze standard CMOS gates, including NOT and NAND structures. *Circuit Analysis*: Evaluate propagation delay and power consumption in fundamental circuits.
Coreq.: EECE-420. Course Offering: FALL

EECE-421 Power Systems Analysis **3 Credits**
Covers one-line diagram per unit quantity, power generation and synchronous machines, transmission line theory, analysis of interconnected systems using load flow studies and computation techniques. Economic operation of power system. Design Projects.
Prereq.: EECE-325. Course Offering: FALL.

EECE-422 Power Communications & Control **3 Credits**
Continuation of EECE-421. Introduction to Telecommunication, Fundamentals of Communications, Data Representation and Communication, Power System and Fault Analysis, Protection and

Controls, Power System Stability, Communication Protocol Concepts and Security and Standards.
Prereq.: EECE-421. Course Offering: SPRING.

EECE-443 Introduction to Microwaves **3 Credits**
Electromagnetic wave propagation, microwave transmission systems, tube and solid-state microwave devices, and waveguides. Time-domain reflections, matching, Smith chart, S-parameters analysis, active and passive microwave components. Microwave measurement techniques.
Prereq.: EECE-305. Course Offering: SPRING.

EECE-444 Antenna Theory and Practice **3 Credits**
Antenna parameters; polarization of electromagnetic waves; basic antenna types; antenna arrays; broadband antenna design. Electrically small wire type apertures antenna design, measurements and simulation using Matlab or Mathcad.
Prereq.: EECE-305. Course Offering: SPRING

EECE-446 ASIC Design **3 Credits**

Course Offering:

EECE-453 Communications Theory **3 Credits**
Includes probability theory, hypothesis testing, channel capacity, coding, detection and system performance analysis.
Prereq.: EECE-331 or EECE-333. Course Offering: FALL.

EECE-454 Communication Electronics **3 Credits**
Spectrum and noise measurements. Analog and digital communication techniques. Design of AM and ASK detectors, FM and FSK modulators and phase lock loops.
Prereq.: EECE-309. Course Offering: SPRING.

EECE-456 Embedded Systems Design Lab **3 Credits**
Project based course for design and system integration of embedded systems using microprocessor boards and I/O devices.
Prereq: EECE-416. Course Offering: SPRING.

EECE-459 Communications Theory Lab **1 Credit**
Design of modulation and demodulation circuits, filters.
Coreq: EECE-453. Course Offering: FALL.

EECE-460 Wireless Communication **3 Credits**
The physical layer of wireless communication systems. Implementation of speech coding, error control, modulation/demodulation and filtering schemes for wireless links using digital signal processors for baseband functions.
Prereqs.: EECE-453. Course Offering: SPRING

EECE-461 Solid State Electronics I **3 Credits**
Semiconductor properties, valence bands, energy bands, equilibrium distribution of electrons and non-equilibrium transport of charges, Breakdown mechanisms; essential features of small ac characteristics, switching and transient behavior of p-n junctions.
Prereq.: EECE-309. Course Offering: SPRING

EECE-462 Solid State Electronics II **3 Credits**
Semiconductor electronic properties and applications to electronic devices; Tunnel and Zener diodes, point contact transistors, FETs, MOSFETS, BJTS, multi junction devices, and small, medium and large scale integrated circuits.
Prereq.: EECE-461. Course Offering: FALL

EECE-463 Digital Electronics **3 Credits**
Bipolar and MOS field effect transistor characterization; characteristics and applications of TTL integrated circuits, design of memories, digital processors, special computer architecture, interfaces and A/D and D/A converters.
Prereqs.: EECE-309. Course Offering: SPRING

EECE-465 Physical Electronics **3 Credits**
Analysis of semiconductor device characteristics, junction breakdown, base-width modulation and capacitive effects. Model derivations from physical considerations.
Prereqs.: PHYS-014 and EECE-309. Course Offering: SPRING

EECE-466 Advanced Electromagnetic Theory **3 Credits**
Propagation of electromagnetic waves in general waveguides, losses in waveguides, fields and matter interaction, electromagnetic theory and special relativity, ionospheric propagation.
Prereq. EECE-305. Course Offering: SPRING.

EECE-471 Design of Integrated Circuits **3 Credits**
Microelectronics and circuit design. In depth coverage of Silicon integrated device characteristics and fabrication.
Prereqs.: EECE-309. Course Offering: FALL.

EECE-477 Design of Integrated Circuits Lab **3 Credits**
In depth theoretical and experimental microelectronics through hands-on circuit design and testing. Detailed coverage of Silicon integrated device characteristics and fabrication.
Prereq.: EECE-471. Course Offering: SPRING.

EECE-479 Cybersecurity for Net CPS/IoT **3 Credits**
This course is designed to introduce emerging topics related to cybersecurity challenges and practical cyber-defense/countermeasures in networked Cyber-Physical Systems (CPS) and Internet-of-Things (IoT). The course will cover fundamental concepts, technologies, theoretical understanding and practical basis for cybersecurity of networked CPS/IoT. Graduate students will complete an independent research project which involves a written and oral presentation not required at the undergraduate level.
Course Offering: FALL.

EECE-481 Advanced Integrated Circuit Design **3 Credits**
This course focuses on the design and implementation of a moderate-sized digital, analog, or mixed-signal integrated circuit using modern semiconductor technologies and industry-standard EDA tools. Topics include system specification, chip design, design-for-testability, floorplanning, and full-chip integration and verification. Students gain hands-on experience with the complete IC design flow from concept through GDSII generation and tapeout, while evaluating key design metrics such as area, speed, and power.
Course Offering: SPRING.

EECE-482 Integrated Circuit Validation **3 Credits**
This course builds on Advanced Integrated Circuit Design and focuses on the post-silicon validation and verification of fabricated integrated circuits. Topics include silicon bring-up, test development, debugging methodologies, and performance characterization. Students gain practical experience in evaluating fabricated chips, identifying design and implementation issues, and applying industry-standard validation and debugging techniques.
Course Offering: FALL.

EECE-487 Telecommunications **3 Credits**
Consists of telecommunications systems design for point-to-point and mass data distribution, modulation techniques, propagation modes and control methods.
Prereq.: EECE-453. Course Offering: SPRING

EECE-495 Signal Processing **3 Credits**
Sampling as a modulation process; aliasing; the sampling theorem; the Z-transform and discrete-time system analysis; direct and computer-aided design of recursive and non recursive digital filters; the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT); digital filtering using the FFT; analog-to-digital and digital-to-analog conversion; effects of quantization and finite-word-length arithmetic, and design and implementation of these algorithms on Motorola family of Digital Signal Processor chips and/or other similar DSP chips.
Prereq.: EECE-333. Course Offering: FALL

EECE-498 Independent Project **3 Credits**
Study performed by individual student under faculty supervision.
Prereq.: Departmental approval. Course Offering: FALL/SPRING.

EECE-496 Integrated Circuits Tech Lab **3 Credits**
This laboratory course is to serve as a hands-on introduction to the environment, processes, and procedures that can be used in the processing of semiconductor materials, and fabrication of nanostructures. Processes that will be performed include lithography, metallization, materials characterization, etc. The evaluation procedures associated with each process will also be examined. Students will process semiconductor wafers resulting in the formation of actual device structures.

EECE-499 Special Topics in Electrical Engineering **3 Credits**
Special courses not offered on a regular basis. Prereq.: Departmental approval.
Course Offering: FALL/SPRING.

IV. EECS FACULTY

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V. CODE OF ETHICS OF ENGINEERS

The Fundamental Principles

Engineers 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 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.

VI. POLICY ON EQUAL OPPORTUNITY

The mission of Howard University includes the provision of quality education for any student, but with emphasis upon the provision of educational opportunities for those students who may not otherwise have an opportunity to acquire an education of the type provided at Howard. In fulfilling its mission, the university does not discriminate on the basis of race, color, national and ethnic origin, sex, marital status, religion, or handicap in the administration of its educational policies, admissions policies, scholarship and loan programs, and other University administered programs and employment.

Howard University is committed to equal opportunity in all aspects of its relations with faculty, students, and staff members without regard to race, color, national and ethnic origin, sex, marital status, religion, age or handicap. The requirement not to discriminate in education programs and activities extends to employment therein and admission thereto.

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Charles Kim, Ph.D.
Interim Chair and Professor