ELECTRICAL AND COMPUTER ENGINEERING, MASTER OF SCIENCE

Concentrations are offered in Communications and Networking as well as Photonics. A Concentration can be selected but is not required.

Admission Requirements

Applicants (degree seeking and special student) must meet the general requirements for admission to graduate study, as outlined in the Admission Requirements (https://e-catalogue.jhu.edu/engineering/engineering-professionals/admission-requirements/). Applicants are expected to hold a degree in electrical and/or computer engineering issued by a program accredited by the Engineering Accreditation Commission (EAC) of ABET, http://www.abet.org, in order to be admitted to the Master of Science in Electrical and Computer Engineering program. Those who majored in a related science or engineering field may also be accepted as candidates, provided their background is judged by the admissions committee to be equivalent to that stated above. Applicants’ prior education should include the following prerequisites:

1. mathematics through vector calculus and differential equations,
2. calculus-based physics,
3. linear and non-linear circuits,
4. electromagnetics, and
5. signals and systems

Applicants whose prior education does not include the prerequisites listed above may still enroll under provisional status, followed by full admission status once they have completed the missing prerequisites. Missing prerequisites may be completed with Johns Hopkins Engineering (all prerequisites beyond calculus are available) or at another regionally accredited institution. Admitted students typically have earned a grade point average of at least 3.0 on a 4.0 scale (B or above) in the latter half of their undergraduate studies. Transcripts from all college studies must be submitted. When reviewing an application, the candidate’s academic and professional background will be considered.

Exceptions to these requirements can be made by the program chair or admissions committee.

Program Requirements

Ten courses must be completed within five years. At least seven of the ten courses must be from the Electrical and Computer Engineering program (EN.525.xxx) or the Department of Electrical and Computer Engineering (EN.520.xxx) in the full-time program, and at least four of the ten required courses must be at the 700-level or above. Approved transfer courses count as 600-level courses.

At most, three of the ten courses required for the MS degree may be selected from outside the program, subject to advisor approval. Students who take an elective outside of the program typically select from the Applied and Computational Mathematics (EN.625.xxx), Applied Physics (EN.615.xxx), and Computer Science (EN.605.xxx) programs.

Limited opportunity is available for replacement of coursework by appropriate project work (EN.525.801 Special Project I and EN.525.802 Special Project II) or through a graduate thesis (EN.525.803 Electrical and Computer Engineering Thesis and EN.525.804 Electrical and Computer Engineering Thesis). Note that EN.615.641 Mathematical Methods for Physics and Engineering, EN.615.642 Electromagnetics, EN.615.780 Optical Detectors & Applications, and EN.625.743 Stochastic Optimization & Control are counted as Electrical and Computer Engineering courses rather than electives. Only one C-range grade (C+, C, or C–) can count toward the master’s degree. All course selections outside of the Electrical and Computer Engineering program requirements are subject to advisor approval.

Concentrations

A concentration or focus area is not required for this program.

Communications and Networking

Ten courses must be completed within five years. Of the minimum of seven Electrical and Computer Engineering courses, at least five must be Communications and Networking courses. Of the maximum of three electives, at least two must be Computer Science Communications and Networking courses. Only one C-range grade (C+, C, or C–) can count toward the master’s degree.

Concentrations are noted on the student’s transcript.

Photonics

Ten courses must be completed within five years. The curriculum consists of four photonics core courses and three additional photonics courses, with the three remaining courses selected to fulfill the MS degree requirements. Only one C-range grade (C+, C, or C–) can count toward the master’s degree.

Concentrations are noted on the student’s transcript.

Courses

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<tr>
<th>Code</th>
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<td>EN.525.201</td>
<td>Circuits, Devices and Fields</td>
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<td>EN.525.202</td>
<td>Signals and Systems</td>
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Focus Areas (A Focus Area can be selected)

Communications and Networking (p. 2)

Computer Engineering (p. 2)

Electronics and the Solid State (p. 2)

Optics and Photonics (p. 2)

RF and Microwave Engineering (p. 2)

Signal Processing (p. 3)

Systems and Controls (p.    )

Concentrations (A Concentration can be selected)

Communications & Networking (p. 3)

Photonics (p. 4)

1 Applicants whose prior education does not include the prerequisites listed under Admission Requirements (p. 1) may still be admitted under provisional status, followed by full admission once they have completed the missing prerequisites. All prerequisite courses beyond calculus are available at Johns Hopkins Engineering. These courses do not count toward the degree or certificate requirements.
Focus Areas

The focus areas offered represent technology groupings that are relevant for students with interests in the selected areas. Students are not required to choose a focus area to follow. They only serve as an aid to students in planning their course schedules. They do not appear as official designations on a student's transcript or diploma.

## Communications and Networking

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<tr>
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<td>Next Generation Telecommunications</td>
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<td>EN.525.614</td>
<td>Probability &amp; Stochastic Processes for Engineers</td>
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<td>EN.525.616</td>
<td>Communication Systems Engineering</td>
<td>3</td>
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<td>EN.525.618</td>
<td>Antenna Systems</td>
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<td>EN.525.620</td>
<td>Electromagnetic Transmission Systems</td>
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</tr>
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<td>EN.525.638</td>
<td>Introduction to Wireless Technology</td>
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<td>EN.525.640</td>
<td>Satellite Communications Systems</td>
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<tr>
<td>EN.525.641</td>
<td>Computer and Data Communication Networks I</td>
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<td>EN.525.654</td>
<td>Communications Circuits Lab</td>
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<td>EN.525.678</td>
<td>Next Generation Mobile Networks with 5G</td>
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<td>EN.525.707</td>
<td>Error Control Coding</td>
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<td>Iterative Methods in Communications Systems</td>
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<td>MIMO Wireless Communications</td>
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<td>Speech Processing</td>
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<td>Software Radio for Wireless Communications</td>
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<td>EN.525.752</td>
<td>Digital Receiver Synchronization Techniques</td>
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<td>EN.525.754</td>
<td>Wireless Communication Circuits</td>
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<td>EN.525.759</td>
<td>Image Compression, Packet Video, and Video Processing</td>
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<td>EN.525.761</td>
<td>Wireless and Wireline Network Integration</td>
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<td>EN.525.768</td>
<td>Wireless Networks</td>
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<td>Propagation of Radio Waves in the Atmosphere</td>
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<td>EN.525.772</td>
<td>Fiber-Optic Communication Systems</td>
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<td>EN.525.776</td>
<td>Information Theory</td>
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<td>Spread Spectrum Communications</td>
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<td>Microwave Communications Lab</td>
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<td>EN.525.793</td>
<td>Advanced Communication Systems</td>
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## Computer Engineering

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<tr>
<td>EN.525.610</td>
<td>Microprocessors for Robotic Systems</td>
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<tr>
<td>EN.525.612</td>
<td>Computer Architecture</td>
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<td>EN.525.615</td>
<td>Embedded Microprocessor Systems</td>
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<td>EN.525.634</td>
<td>High Speed Digital Design</td>
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<td>EN.525.641</td>
<td>Computer and Data Communication Networks I</td>
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<tr>
<td>EN.525.642</td>
<td>FPGA Design Using VHDL</td>
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<td>EN.525.712</td>
<td>Advanced Computer Architecture</td>
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<td>EN.525.742</td>
<td>System-on-a-Chip FPGA Design Laboratory</td>
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<td>EN.525.743</td>
<td>Embedded Systems Development Lab</td>
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## Electronics and the Solid State

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<td>EN.525.606</td>
<td>Electronic Materials</td>
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<td>EN.525.607</td>
<td>Intro to Electronic Packaging</td>
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<td>EN.525.621</td>
<td>Introduction to Electronics and the Solid State</td>
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<td>EN.525.624</td>
<td>Analog Electronic Circuit Design</td>
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<td>EN.525.651</td>
<td>Introduction to Electric Power Systems</td>
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<td>Communications Circuits Lab</td>
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<td>EN.525.658</td>
<td>Digital VLSI System Design</td>
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<td>Mixed-Mode VLSI Circuit Design</td>
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<td>EN.525.674</td>
<td>Introduction to RF and Microwave Circuits</td>
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<td>EN.525.725</td>
<td>Power Electronics</td>
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<td>EN.525.732</td>
<td>Advanced Analog Electronic Circuit Design</td>
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<td>Wireless Communication Circuits</td>
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<td>EN.525.774</td>
<td>RF &amp; Microwave Circuits I</td>
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<td>EN.525.775</td>
<td>RF &amp; Microwave Circuits II</td>
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<td>EN.525.779</td>
<td>RF Integrated Circuits</td>
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<td>EN.525.787</td>
<td>MMIC Design</td>
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<td>EN.525.788</td>
<td>Power Microwave Monolithic Integrated Circuit (MMIC) Design</td>
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## Optics and Photonics

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<td>Advanced Topics in Optical Medical Imaging</td>
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<td>EN.525.613</td>
<td>Fourier Techniques in Optics</td>
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<td>EN.525.625</td>
<td>Laser Fundamentals</td>
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<td>EN.525.636</td>
<td>Optics &amp; Photonics Lab</td>
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<td>EN.525.691</td>
<td>Fundamentals of Photonics</td>
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<td>EN.525.753</td>
<td>Laser Systems and Applications</td>
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<td>EN.525.756</td>
<td>Optical Propagation, Sensing, and Backgrounds</td>
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<td>Fiber-Optic Communication Systems</td>
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<td>EN.525.796</td>
<td>Introduction to High-Speed Optoelectronics</td>
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<tr>
<td>EN.525.797</td>
<td>Advanced Fiber Optic Laboratory</td>
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## RF and Microwave Engineering

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<tr>
<td>EN.525.605</td>
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<td>Electromagnetic Transmission Systems</td>
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<td>EN.525.623</td>
<td>Principles of Microwave Circuits</td>
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<td>EN.525.648</td>
<td>Introduction to Radar Systems</td>
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<td>Communications Circuits Lab</td>
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<td>EN.525.674</td>
<td>Introduction to RF and Microwave Circuits</td>
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<td>EN.525.684</td>
<td>Microwave Systems &amp; Receiver Design</td>
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<td>EN.525.754</td>
<td>Wireless Communication Circuits</td>
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<td>Propagation of Radio Waves in the Atmosphere</td>
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<td>EN.525.774</td>
<td>RF &amp; Microwave Circuits I</td>
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<td>EN.525.775</td>
<td>RF &amp; Microwave Circuits II</td>
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Electrical and Computer Engineering, Master of Science 3

Signal Processing

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<td>EN.525.779</td>
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<td>EN.525.787</td>
<td>MMIC Design</td>
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<tr>
<td>EN.525.788</td>
<td>Power Microwave Monolithic Integrated Circuit (MMIC) Design</td>
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<td>EN.525.790</td>
<td>RF Power Amplifier Design Techniques</td>
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<td>Microwave Communications Lab</td>
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<td>EN.615.642</td>
<td>Electromagnetics</td>
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Special Project/Thesis Courses

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<td>EN.525.802</td>
<td>Special Project II</td>
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<td>EN.525.803</td>
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<td>EN.525.804</td>
<td>Electrical and Computer Engineering Thesis</td>
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Courses by Concentration

Communications and Networking

Select five of the following:

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<td>Next Generation Telecommunications</td>
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<td>Probability &amp; Stochastic Processes for Engineers</td>
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<td>Communication Systems Engineering</td>
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<td>Antenna Systems</td>
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<td>Electromagnetic Transmission Systems</td>
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<td>Introduction to Wireless Technology</td>
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<td>Satellite Communications Systems</td>
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<td>Computer and Data Communication Networks I</td>
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<td>Communications Circuits Lab</td>
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<td>Next Generation Mobile Networks with 5G</td>
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<td>EN.525.707</td>
<td>Error Control Coding</td>
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<td>Iterative Methods in Communications Systems</td>
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<td>Wireless and Mobile Cellular Communications</td>
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<td>MIMO Wireless Communications</td>
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<td>Wireless Communication Circuits</td>
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<td>Image Compression, Packet Video, and Video Processing</td>
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Systems and Controls

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<td>EN.520.633</td>
<td>Intro To Robust Control</td>
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<td>EN.520.636</td>
<td>Feedback Control in Biological Signaling Pathways</td>
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<td>Foundations of Reinforcement Learning</td>
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<td>Continuous Control Systems</td>
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<td>Probability &amp; Stochastic Processes for Engineers</td>
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<td>Microwave Communications Lab</td>
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Electrical and Computer Engineering, Master of Science 3
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<tr>
<td>EN.525.783</td>
<td>Spread Spectrum Communications</td>
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<td>Computer Network Architectures and Protocols</td>
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<td>Network Programming</td>
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<td>Next Generation Mobile Networks with 5G</td>
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### Photonics

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<td>EN.525.625</td>
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### Electives

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<td>Introduction to High-Speed Optoelectronics</td>
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1 Only one 615.XXX course is required.

2 EN.525.801 Special Project I and EN.525.802 Special Project II courses can also be used to allow students to pursue specialized interests in optics.

Please refer to the course schedule (ep.jhu.edu/schedule (https://apps.ep.jhu.edu/schedule/search/)) published each term for exact dates, times, locations, fees, and instructors.