Mathematics Requirements

Basic Courses Required of All ECE Majors

All ECE majors must successfully complete, or receive Advanced Placement (or transfer) Credit, for each of the following basic mathematics courses:

- MATH 111L (31L): Laboratory Calculus I. Functions, limits, continuity, trigonometric functions, techniques and applications of differentiation, indefinite and definite integrals, the fundamental theorem of calculus. MATH 21 (31) AP credit is also acceptable. Students who have AP credit for MATH 21 (31) but not MATH 22 (32) can take MATH 122L (41L) in the Fall or MATH 112L (32L) in the spring.
- MATH 112L (32L): Laboratory Calculus II. Methods of integration, applications of integrals, functions defined by integration, improper integrals, introduction to probability and distributions, infinite series, Taylor polynomials, series solutions of differential equations, systems of differential equations, Fourier series. MATH 22 (32) AP Credit or MATH 122L (41L) are also acceptable. Students who have AP credit for both MATH 21 (31) and 22 (32) or who have taken MATH 122L (41L) may proceed to MATH 212 (103).
- MATH 212 (103): Intermediate Calculus. Partial differentiation, multiple integrals, and topics in differential and integral vector calculus, including Green's theorem, the divergence theorem, and Stoke's theorem.
- STA 130 (113) or MATH 230 (135) or ECE 380 or ECE 555 (255): Probability/Statistics.
    - STA 130 (113) provides an introduction to probability, independence, conditional independence, Bayes' theorem; discrete and continuous, univariate and multivariate distributions; linear and nonlinear transformations of random variables; classical and Bayesian inference, decision theory, and comparison of hypotheses; and experimental design, statistical quality control, and other applications in engineering.
    - ECE 380 provides an introduction to probability and random processes with example applications to processing data with uncertainty. Probability, conditional probability, discrete and continuous random variables, expected values, characteristic functions, multiple random variables. Intro to random processes, random discrete-time signals, power spectrum, autocorrelation, analysis of linear systems driven by wide-sense stationary random processes.
    - ECE 555 (255) is an upper-level course introducing basic concepts and techniques for the stochastic modeling of systems, including elements of probability, statistics, queuing theory and estimation.
    - Students who wish to have a more in-depth treatment of probability theory *per se* may take MATH 230 (135).

  STA 130 (113), MATH 230 (135), and ECE 380 may be taken before or after the two required advanced courses described below; ECE 555 (255) requires at least one of those as a prerequisite. Most students take the advanced math courses directly after completing MATH 212 (103).

Students who receive Advanced Placement credit for MATH 21 (31) and who choose to enter MATH 112L (32L) or MATH 122L (41L) directly will be considered to have met the

completion requirement for MATH 111L (31L). Similarly, students who have received AP credit for both MATH 21 (31) and MATH 22 (32) and who choose to enter MATH 212 (103) directly will be considered to have met the completion requirement for both MATH 111L (31L) and MATH 112L (32L). Engineering students should consider placing out of both MATH 111L (31L) and MATH 112L (32L) only if they have a score of 5 on the advanced section of the Math AP test and feel very confident with integral calculus.

Students who do not have AP (or transfer) credit for MATH 21 (31), MATH 22 (32) and/or other basic MATH courses may enter the higher-level courses directly on the basis of strong prior preparation, **but they must successfully complete a total of five college-level MATH courses at Duke or by transfer credit, including the required advanced courses of the next paragraph.**[1] Students who elect on the basis of strong prior preparation to skip two or more of the listed basic MATH courses should discuss their situation with Dr. Huettel or their Academic Dean before the end of the drop/add period of their first semester in Pratt.

Advanced Courses Required of All ECE Majors

In addition to the above set of four required basic mathematics courses, all ECE majors must take the following two advanced math courses designed specifically for engineering and science students:

- MATH 216 (107): Linear Algebra and Differential Equations. Systems of linear equations, matrix operations, vector spaces, linear transformations, orthogonality, determinants, eigenvalues and eigenvectors, diagonalization, linear differential equations and systems with constant coefficients and applications, computer simulations. Not open to students who have had MATH 221 (104).
- MATH 353 (108): Ordinary and Partial Differential Equations. First and second order ordinary differential equations with applications, Laplace transforms, series solutions and qualitative behavior, Fourier series, partial differential equations, boundary value problems, Sturm-Liouville theory. Not open to students who have had MATH 356 (131).

Students who matriculated in Fall 2006 and thereafter must take the MATH 216 (107) and 353 (108) course pair, except that students pursuing a dual major in ECE and MATH can satisfy the ECE Advanced Courses requirement by taking the two MATH courses 221 (104) and 356 (131), a normal part of that dual major. Students who start with MATH 221 (104) must take the second course MATH 356 (131).

1 STA 130 (113), ECE 380, and ECE 555 (255) are considered MATH courses for the purpose of this requirement.