Bulletin of
Duke University

Duke University
About the University Bulletins

The Office of the University Registrar is responsible for compiling, producing, and maintaining the bulletin for each school at Duke University. The content for the bulletins is established by the schools in conjunction with the Duke University Bulletins Policy.

All bulletins are published online and serve as static documents for historical records of the university. The university reserves the right to change programs of study, academic requirements, teaching staff, the calendar, and other matters described herein without prior notice, in accordance with established procedures.

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The information in this bulletin applies to the academic year 2022-2023 and is accurate and current, to the greatest extent possible, as of August 2022. The university reserves the right to change programs of study, academic requirements, teaching staff, the calendar, and other matters described herein without prior notice, in accordance with established procedures. Duke University is committed to encouraging and sustaining a learning and work community that is free from prohibited discrimination and harassment. The institution prohibits discrimination on the basis of age, color, disability, gender, gender identity, gender expression, genetic information, national origin, race, religion, sex, sexual orientation, or veteran status, in the administration of its educational policies, admission policies, financial aid, employment, or any other institution program or activity. It admits qualified students to all the rights, privileges, programs, and activities generally accorded or made available to students.

Sexual harassment and sexual misconduct are forms of sex discrimination and prohibited by the institution. Duke has designated the Vice President for Institutional Equity and Chief Diversity Officer as the individual responsible for the coordination and administration of its nondiscrimination and harassment policies. The Office for Institutional Equity is located in Smith Warehouse, 114 S. Buchanan Blvd., Bay 8, Durham, NC 27708, and can be contacted at (919) 684-8222.

Questions or comments about harassment or discrimination can be directed to the following administrator in the Office for Institutional Equity:

**Discrimination in employment or educational programs and activities**
Cynthia Clinton, AVP Harassment and Discrimination Prevention and Compliance
Office for Institutional Equity
114 S. Buchanan Blvd., Bay 8
Durham, NC 27708
(919) 668-6214

Additional information, including the complete text of Duke’s Policy on Prohibited Discrimination, Harassment, and Related Misconduct and appropriate complaint procedures, may be found by visiting the Office for Institutional Equity’s website at oie.duke.edu. For further information, visit ed.gov/about/offices/list/ocr/index.html, or call (800) 421-3481.

Duke University recognizes and utilizes electronic mail as a medium for official communications. The university provides all students with email accounts as well as access to email services from public clusters if students do not have personal computers of their own. All students are expected to access their email accounts on a regular basis to check for and respond as necessary to such communications.
Information that the university is required to make available under the federal Clery Act is available by visiting the Records Division, Duke University Police Department, 502 Oregon Street, Durham, NC 27708, or by calling (919) 684-4602. See police.duke.edu/news-stats/clery for more details.

The Family Educational Rights & Privacy Act (FERPA), 20 U.S.C § 1232g; 34 CFR Part 99, is a federal law that guides the release of students’ education records, of which disciplinary records are a part. For additional information about FERPA, see ed.gov/policy/gen/guid/fpco/ferpa/index.html.

Duke University is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools to award baccalaureate, master’s, doctorate, and professional degrees. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, GA 30033-4097 or call (404) 679-4500 for questions about the accreditation of Duke University.

This publication is available in alternative format on request. Please call (919) 684-2813.
Mission Statement

Approved by the Duke University Board of Trustees October 1, 1994, and revised February 23, 2001, the Mission Statement for Duke University reads as follows:

"James B. Duke’s founding Indenture of Duke University directed the members of the University to ‘provide real leadership in the educational world’ by choosing individuals of ‘outstanding character, ability, and vision’ to serve as its officers, trustees and faculty; by carefully selecting students of ‘character, determination and application;’ and by pursuing those areas of teaching and scholarship that would ‘most help to develop our resources, increase our wisdom, and promote human happiness.’

"To these ends, the mission of Duke University is to provide a superior liberal education to undergraduate students, attending not only to their intellectual growth but also to their development as adults committed to high ethical standards and full participation as leaders in their communities; to prepare future members of the learned professions for lives of skilled and ethical service by providing excellent graduate and professional education; to advance the frontiers of knowledge and contribute boldly to the international community of scholarship; to promote an intellectual environment built on a commitment to free and open inquiry; to help those who suffer, cure disease, and promote health, through sophisticated medical research and thoughtful patient care; to provide wide-ranging educational opportunities, on and beyond our campuses, for traditional students, active professionals and life-long learners using the power of information technologies; and to promote a deep appreciation for the range of human difference and potential, a sense of the obligations and rewards of citizenship, and a commitment to learning, freedom and truth.

"By pursuing these objectives with vision and integrity, Duke University seeks to engage the mind, elevate the spirit, and stimulate the best effort of all who are associated with the University; to contribute in diverse ways to the local community, the state, the nation and the world; and to attain and maintain a place of real leadership in all that we do."
Duke University: A Brief Narrative History

Duke University traces its origins to a small school that opened in 1838 in Randolph County, North Carolina. Originally a preparatory school for young men called the Union Institute Academy, it was then chartered as a teaching college named Normal College by the state of North Carolina in 1851. The school underwent another transformation in 1859 when it turned to the Methodist Church for financial support. Reflecting the new partnership, the school’s name changed to Trinity College.

From 1842 to 1882, Braxton Craven served as the principal and then president of the institution, overseeing its transition from a tiny schoolhouse to a full-fledged college. Shortly before his death, he helped to establish the Cherokee Industrial School at Trinity College, one of numerous schools established in the United States to “westernize” indigenous students, in this case boys and young men from the Eastern Band of the Cherokee. The School at Trinity lasted only a few years. It is worth noting that Craven enslaved several Black people prior to the Civil War, and that a number of other faculty and trustees were also enslavers.

John F. Crowell, Trinity College’s president from 1887-1894, suggested that moving the college to an urban setting would attract more students, faculty, and financial support. With Crowell’s encouragement, the trustees agreed to move the college, and after a spirited competition among regional cities, Trinity opened in Durham in 1892. Local tobacco magnates Washington Duke and Julian S. Carr assisted in providing land and money to Trinity. In 1897, at Washington Duke’s request, the school began admitting women as regular students, making it an early co-educational institution. Carr’s support for Trinity College was recognized with a building named in his honor in 1930. His name was removed in 2018 in light of his virulent white supremacist beliefs and actions.

Trinity prospered in its new location, and in 1924 the school was again transformed through philanthropy. Washington Duke’s son James Buchanan Duke established the Duke Endowment, and the charitable foundation infused the college with funds. The trustees changed Trinity College’s name to Duke University as a memorial to his father. The new funds supported the construction of a new campus, designed in a Gothic style by the Philadelphia architectural firm of Horace Trumbauer. The chief designer of West Campus, as well as the re-envisioned East Campus, was Julian Abele, a Black architect whose role in creating the architecture of Duke University was largely overlooked during his lifetime. In 2016, the main quad on West Campus was renamed Abele Quad in his honor.

President William P. Few (1910-1940) oversaw this metamorphosis of a small college into a complex university. In 1930, the Trinity College site (today’s East Campus) became the Woman’s College, while the West Campus served as the grounds for the all-male Trinity College. In 1972, Trinity College merged both colleges of men and women into what is now known as Trinity College of Arts and Sciences. Other schools include the School of Religion and Graduate School founded in 1926, the School of Medicine and hospital in 1930, and the School of Nursing in 1931. Originally established in 1904, the Law School reorganized in 1930. In 1938, what is today’s Sanford School of Public Policy became Duke’s tenth school in 2005. The school was named for President Terry Sanford, formerly the governor of North Carolina, who supported a number of initiatives in the 1970s and 1980s to build Duke’s reputation for excellence, growing the university’s national and international profile.

Long a segregated institution, Duke first admitted Black graduate and professional students in 1961 and Black undergraduates in 1963. In 1968, a major student protest known as the Vigil demanded pay increases and better treatment of hourly workers, most of whom were Black. In 1969, Black students protested in what is now known as the Allen Building Takeover, demanding improved services and treatment for Black students. The protest resulted in the formation of what is now called the Department of African and African American Studies.

Faculty at Duke produce influential scholarship across a wide range of disciplines and professions. Two Duke faculty members have received the Nobel Prize in Chemistry: Professor Robert Lefkowitz in 2012 and Professor Paul Modrich in 2015. Duke researchers have mapped the human chromosome and led research into the treatment of HIV and AIDS. Duke faculty also research pressing social issues, producing high-impact scholarship on such topics as election districting and public health. Faculty authors have written books of award-winning nonfiction, fiction, and poetry, and have won awards ranging from the National Book Award to the Pulitzer Prize. Fifty Duke faculty are members of the American Academy of Arts and Sciences. Duke students have many opportunities to work with leading faculty in labs and on projects, ensuring hands-on experience during their course of study.

Duke has a number of notable athletic achievements. Best known is the men’s basketball team, coached by Mike Krzyzewski from 1980 to 2022. The team has earned 5 national championships. The women’s golf team holds the record at Duke for most national championships, at 7. Duke football has been played since the 1880s, when President Crowell coached the team himself. During the 1930s and 1940s, the football team competed in and won a number of bowl games, earning the nickname “Iron Dukes.” The Rose Bowl game of 1942 was played in Durham due to wartime concerns on the West Coast and remains the only Rose Bowl played outside of Pasadena, California.
International programs have expanded over the last several decades, bringing international students to Duke in Durham and expanding international opportunities for Duke students. In 2005, Duke partnered with the National University of Singapore and opened the Duke-NUS Medical School. In 2014, graduate programs at Duke Kunshan University began, followed by undergraduate programs in 2018. DKU is a partnership between Duke and Wuhan University in Kunshan, China.

The university has changed in many ways since its founding, and like other historically white schools it continues to confront issues of racism, sexism, and other inclusion and equity challenges. Students of color and international students now represent more than 50% of the student body. Duke’s hometown of Durham has also grown and changed, and Duke and Durham collaborate on topics ranging from community service to downtown development.

Ever evolving, Duke University strives to meet the stated aims of the university: “to foster a lively relationship between knowledge and faith; to advance learning in all lines of truth; to defend scholarship against all false notions and ideals; to develop a love of freedom and truth; to promote a respectful spirit of dialogue and understanding; to discourage all partisan and sectarian strife; and to further the advancement of knowledge in service to society.”
Leadership

Full leadership profiles for those listed below are available at duke.edu/about/leadership.

Executive Leadership

Vincent Price, PhD, President | president.duke.edu
Daniel Ennis, MBA, MPA, Executive Vice President
A. Eugene Washington, MD, Chancellor for Health Affairs, Duke University, President and CEO, DUHS
Sally Kornbluth, PhD, Provost

Academic Leadership

Deans of Schools and Colleges

Kerry Abrams, James B. Duke and Benjamin N. Duke Dean of the School of Law
William Boulding, Dean, Fuqua School of Business
Edgardo Colón-Emeric, Dean, Divinity School
Vincent Guilamo-Ramos, Dean, School of Nursing and Vice Chancellor for Nursing Affairs
Judith Kelley, Dean, Sanford School of Public Policy
Mary E. Klotman, Dean, School of Medicine
Jerome P. Lynch, Dean, Pratt School of Engineering
Mohamed Noor, Interim Dean of Trinity College of Arts and Sciences
Toddi Steelman, Stanback Dean, Nicholas School of the Environment

Vice Provosts

Edward Balleisen, Phd, Vice Provost for Interdisciplinary Studies
Abbas Benmamoun, Phd, Vice Provost for Faculty Advancement
Gary Bennett, Phd, Vice Provost for Undergraduate Education
John Brown, Vice Provost for the Arts
Jennifer Francis, Phd, Executive Vice Provost
Dracine Hodges, Interim University Librarian
Mary Pat McMahon, Vice Provost/Vice President of Student Affairs
James S. Roberts, Vice Provost

University Administration

Pamela J. Bernard, Vice President and General Counsel
Maggie Epps, Secretary to the Board of Trustees and Chief of Staff to the President
Tracy Futhey, Vice President for Information Technology and Chief Information Officer
Leigh P. Goller, Chief Audit, Risk and Compliance Officer
Kimberly Hewitt, Vice President for Institutional Equity and Chief Diversity Officer
David L. Kennedy, Vice President for Alumni Engagement and Development
Nina E. King, Vice President and Director of Athletics
Jennifer Lodge, PhD, Vice President for Research & Innovation
Antwan Lofton, Vice President for Human Resources
John J. Noonan, Vice President for Facilities
Rachel Satterfield, Vice President for Finance
Michael J. Schoenfeld, Vice President for Public Affairs & Government Relations and Chief Communications Officer
Russell Thompson, Vice President for Operations
The Faculty

Duke faculty are chosen from among the most competitive selection processes in the country, having demonstrated excellence in their fields of research. Duke currently has two Nobel Laureates among its faculty. Many others hold appointments in the National Academy of Sciences. Their books and publications are numerous and influential.

Duke professors are also excellent teachers. There is an 8-to-1 ratio of students to faculty. Professors are committed to giving students the individual attention that pushes them to excel while nurturing their ideas. Undergraduates, even in their first year, interact with senior faculty on a regular basis in efforts such as the Focus Program, a series of first-year interdisciplinary seminars focused on a theme. In addition, many serve as advisors to students, including those who choose to design their program of study and as mentors to undergraduates who pursue hands-on research.

Profiles of Duke’s faculty members are available via Scholars@Duke.
Assessment and Accreditation

Assessment

Academic and programmatic assessment at Duke are central to our institutional mission to provide the highest quality education possible. Assessment efforts include evaluating institutional effectiveness, program quality, faculty quality, and student educational outcomes. To be effective evaluators of our programs, we have developed an assessment relevant to each criteria that includes establishing program goals, setting achievement targets, identifying metrics, establishing data capture regimes, communicating findings to decision makers, documenting data-driven actions taken for program improvement, and adapting program metrics to capture the effects of the new initiatives.

Academic assessment is conducted at the program and the school level. The School Assessment Representatives Group coordinates each school’s academic assessment and shares best practices between the schools. The provost-appointed Committee for Assessment of Educational and Administrative Support oversees and provides feedback on assessment of administrative and academic services.

Accreditation

Duke University is accredited by the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC) to award baccalaureate, masters, doctorate, and professional degrees. Contact the Commission on Colleges at (404) 679-4500 for questions about the accreditation of Duke University.

Reaffirmation of accreditation occurs every ten years, with a five year interim review including a report on the progress of the Quality Enhancement Plan. General information on the overall process may be found in the SACSCOC Handbook for Reaffirmation of Accreditation.

Duke’s last reaffirmation of accreditation was conducted in 2019.

In addition to the decennial and mid-point reviews, Duke maintains compliance with policies defined and enforced by SACSCOC. Some of these policies require periodic reporting to our accreditor. The most common policy for which we have to report is Substantive Change.
Duke Community Standard

Duke University is a community dedicated to scholarship, leadership, and service and to the principles of honesty, fairness, respect, and accountability. Citizens of this community commit to reflect upon and uphold these principles in all academic and nonacademic endeavors, and to protect and promote a culture of integrity.

To uphold the Duke Community Standard:

- I will not lie, cheat, or steal in my academic endeavors;
- I will conduct myself honorably in all my endeavors; and
- I will act if the Standard is compromised.

Students' Obligation to Act with Respect to the Duke Community Standard

The Duke Community Standard (DCS) stresses the commitment that students share with all members of the community to enhance the climate for honesty, fairness, respect, and accountability at Duke University. Students affirm their commitment to foster this climate by signing a pledge that includes taking constructive action if they witness or know about behavior they perceive to be inconsistent with the DCS, which may include violation of university policies. Although there are no disciplinary sanctions associated with the failure to act, students are nonetheless expected to take action to do something as a responsibility of membership in the Duke community.

The university recognizes that it is not always easy to act in these situations, but several alternatives are available to suit a student's level of comfort and confidence. These alternatives are not mutually exclusive.

- Speaking directly with the individual exhibiting the behavior, both to gain clarity about the situation and to inform the individual about the concern.
- Publicly calling attention to the behavior as it is occurring.
- For incidents involving social behaviors, alerting residence hall, Student Affairs, or other university staff. The information provided will give staff the opportunity to address the matter informally or through appropriate formal channels.
- For cases involving academic integrity, alerting the instructor that cheating may be occurring in the course. This alert can be in any form, including anonymous notification, and the reporting student will not be identified. The information provided will allow the faculty member to consider corrective measures, in consultation with the Office of Student Conduct and Community Standards, and to address the topic with the class or suspected student(s).
- Directly alerting staff in the Office of Student Conduct and Community Standards at (919) 684-6938 or conduct@duke.edu who will confer with the faculty member involved, if an academic issue, or with the reporting student(s), strategizing next steps. Maintaining the confidentiality of the source is possible, but may limit the extent of action that can be taken.

The Context of the Duke Community Standard

The honor code at Duke is named the community standard because community is at the center of our conception of what it means to act honorably. Community entails a sense of connectedness to others and their welfare, feeling part of Duke University every day and being responsible for its continual improvement. Community refers as well to a feeling of connection to the city in which we are located. It posits the counterbalancing of group benefit with individual needs and wants, and a Duke identity with the many personal identities based on demographics and interest. The kind of environment we strive to achieve is one in which civility (but not docility) reigns; an environment in which ideas are promulgated, and challenged, in a stimulating give and take; an environment in which learning (whether from peers, faculty, administrators, or others in the Duke and broader communities) is accomplished with openness, honesty, and respect.

Citizens of the Duke community commit to acting with purpose, civility, and intention, both with personal decision-making and with interactions with each member of this community. Choosing to be a citizen of the Duke community means acknowledging the value of each member, participating in active reflection and asking the question, “How do my actions impact others?”

The honor code at Duke is named the community standard because it expresses our institution's core values and a concomitant set of expectations for behavior. Because behavior is derivative of fundamental values, the standard applies off campus as well as on. The principles it articulates, while lofty in one sense, are firmly grounded in individual decisions made on the ground every day about every aspect of undergraduate life, in academic and co-curricular activities alike: in the classroom, residence halls, K-ville, off-campus apartment complexes, Myrtle Beach, Paris, and wherever else students may go. In addition, the standard asks that students not only reflect on their own behavior, as important as that is, but that they also act to encourage the integrity of their peers. By inspiring and supporting each other, students can shape their environment so that it reflects the ideals expressed in the Duke Community Standard.
Duke University

The Standard, therefore, expresses our goals for undergraduate education in the broadest sense and is foundational to undergraduate life at Duke. It is followed by an equally important pledge that students sign as members of the community.

Duke University seeks to engage all students in its tradition of honor, a tradition that defines the institution and helps to guide students during their college careers and beyond. The students here today, who are the beneficiaries of the efforts of those who preceded them, have an extraordinarily important role to play in perpetuating and strengthening this tradition. We welcome, and count on, your involvement.

The History of the Duke Community Standard

In 1999-2000, Duke participated in a national survey through the Center for Academic Integrity. Through responses from undergraduate students, as well as from faculty and staff, the survey assessed the climate of academic integrity at Duke in comparative context with other institutions. As a result of the findings, the provost formed the Academic Integrity Council (AIC) in 2001 by appointing representatives from across the community whose charge was to review academic integrity policies and practices and make recommendations to improve the climate of integrity on campus.

An early goal of the AIC was to review the existing Honor Code, which had been in effect for the undergraduate community since 1993. The AIC determined that the Honor Code needed revision to make it shorter while embracing all aspects of a student's life at Duke. A major element of the revision was the inclusion of the fundamental values that must inform the definition of a community of honor.

This Duke Community Standard was proposed to the faculty councils of Trinity College of Arts and Sciences and the Pratt School of Engineering, as well as to the Duke Student Government. It was approved for the undergraduate community and implemented in the fall of 2003. The Standard was also incorporated into the code of each graduate and professional school of the university and, thus, represents the values we uphold as an institution.

Duke University is committed to ongoing evaluation of principles, policies, and practices, and to lively conversation about issues of integrity. Thus, Duke participated again in a national survey on academic integrity in the fall of 2005 and in intensive discussions of academic and social integrity from summer 2006 through spring 2007. The result of these continuing and broadened discussions was a revised Community Standard, put before the undergraduate student body in a student government referendum of April 2007 and overwhelmingly approved. Implemented in summer 2007, the new Duke Community Standard differs from its predecessor chiefly in its level of commitment to taking action (see Students Obligation to Act with Respect to the Duke Community Standard above).

In the spring of 2011, Duke University again surveyed undergraduate students about integrity, this time expanding beyond an academic focus to additional questions about integrity in other domains (i.e., social, work, and civic) inside and outside the classroom. In-depth focus interviews were also conducted with a sample of graduating seniors. Results showed a marked reduction in academic dishonesty in three key areas that were identified as problem areas in the 2005 survey: fabricating or falsifying a bibliography, falsifying or fabricating lab data, and copying or paraphrasing a few sentences without appropriate attribution. One area of concern that emerged from the 2011 survey was an increase in reported unauthorized collaboration. There was also a gap between students' perceptions of the prevalence of dishonesty across these multiple domains and student self-reported rates of engaging in dishonest acts within these domains. Duke University will continue efforts to narrow students' perception of the frequency of academic dishonesty and actual self-reported rates of cheating and other dishonest acts.

A Statement of Principles

The Duke Community Standard expresses a standard for behavior a set of expectations of students who claim membership in Duke's learning community. All incoming undergraduates, upon admittance to Duke, are required to sign a pledge to adhere to these values and to conduct themselves in accordance with these values throughout their undergraduate careers. Likewise, upon completion of each academic assignment, students may be asked to reaffirm their commitment to the Duke Community Standard by signing a statement indicating that they have adhered to the Duke Community Standard in completing the assignment.

The Duke Community Standard, thus, is a statement of principles. The specific policies, or rules and regulations of the university, define the conduct for which students can be held accountable.

University Regulations and the Disciplinary Process

Duke University has high expectations for students' scholarship and conduct. Each student is subject to the rules and regulations of the university currently in effect, or which are put into effect from time to time by the appropriate authorities of the university. At the same time, the individual is responsible for decisions and choices within the framework of the regulations of the community, as Duke does not assume in loco parentis relationships.
Students, in accepting admission, indicate their willingness to subscribe to and be governed by these rules and regulations. They acknowledge the right of the university to take disciplinary action, including suspension or expulsion, for failure to abide by the regulations or for other conduct determined unsatisfactory or detrimental to the university community.

Responsibility for prescribing and enforcing rules and regulations governing student conduct rests ultimately with the Board of Trustees of Duke University and, by delegation, with administrative officers of the university. In the undergraduate schools, and in the university as a whole, many of these rules have been established over the years by cooperative action between students, faculty, and administrative officers. Representative student organizations, such as student governments and conduct boards, and more recently, community-wide bodies of students, faculty, and administrators, have initiated proposals for policies and rules necessary to assure satisfactory standards in academic and nonacademic conduct. These proposals have been accepted by university officers and have become a substantial, if not all-inclusive, body of rules governing student life at Duke. For current regulations, refer to the The Duke Community Standard in Practice: A Guide for Students.
Duke University Policy and Procedures under FERPA

Duke University adheres to a policy of compliance with the Family Educational Rights and Privacy Act. The policy (1) permits students to inspect their education records, (2) limits disclosure to others of personally identifiable information from education records without students' prior written consent, and (3) provides students the opportunity to seek correction of their education records where appropriate.

Definitions

Student. An individual who is, or who has become, in attendance at Duke University. It does not include an individual who was an unsuccessful applicant for admission to the University. A student definition also includes alumni/former students.

In Attendance. A student in attendance can be participating in person or by paper correspondence, video conference, satellite, Internet, or other electronic information and telecommunications technologies for students not physically present in a classroom. Attendance could also be the period in which a person is working in a work-study program. Duke University defines attendance to begin the first day a student arrives on campus for an official, organized campus activity (e.g. orientation, athletic practice, class, etc.) or participates in any official, organized activity offered by technology (e.g. orientation, class, etc.).

Education Records. Education records include those records that are personally identifiable and which are maintained by the University or a University official. Records could be information or data recorded in any medium, including but not limited to photos, handwriting, print, tapes, film, microfilm, and microfiche. Appendix A lists commonly held records by Duke University offices. Any University office or official may have an education record about a student, including offices not listed in the appendix.

The following are not considered education records:

- Records about students made by professors and administrators for their own use and not shown to others.
- Campus police records maintained solely for law enforcement purposes and kept separate from the education records described above.
- Employment records, except where a currently-enrolled student is employed as a result of his or her status as a student (i.e. work-study).
- Records of a physician, psychologist, or other recognized professional or paraprofessional made or used only for treatment purposes and available only to persons providing treatment. However, these records may be reviewed by an appropriate professional of the student's choice.
- Records which contain only information relating to a person's activities after that person is no longer a student at the University.
- Application for admissions records to a Duke University school or program in which the student is not currently in attendance.

Personally Identifiable. Data or information that contains the name of a student; the student's parent or other family member's name; the address of the student, parent, or family member; a personal identifier, such as the social security number or student ID number; other information which would make the student's identity easily traceable.

Directory Information. The following categories of information have been designated directory information at Duke University:

- Name(s)
- Addresses
- Duke Unique ID
- Telephone listing(s)
- Email Addresses
- Place of birth
- Photograph(s)
- Major fields of study
- Participation in officially recognized activities and sports
- Weight and height of members of athletic teams
- Dates of attendance
- Enrollment Status (full/part time)
- Degrees and awards received
- Most recent previous educational institution attended

The University will give annual public notice to students of the categories of information designated as directory information and will allow a reasonable period of time after such notice for the student to inform the University that he/she wishes to suppress the
information from being disclosed. Directory information may appear in public documents and may otherwise be disclosed without student consent unless the student objects as indicated.

Disclosure. Permitting of access or the release, transfer, or other communication of education records orally or in writing, or by electronic means, or by any other means to any party.

School Official. A person employed by the University in an administrative, supervisory, academic, research, or support staff position, including public safety and health care personnel; a person or company with whom the University has contracted (such as an attorney, auditor, or collection agent); a person serving on the Board of Trustees or a student serving on an official committee or assisting another school official in performing his or her tasks. School officials may only access and use education records as necessary to conduct official University business or for which they have legitimate educational interest.

Legitimate Educational Interest. An interest in reviewing student education records for the purpose of performing an appropriate University research, educational, or administrative function. A school official has legitimate educational interest if the need to see an education record is necessary in order to perform his or her professional responsibilities. Interests essential to the general process of higher education, including teaching, research, public service, and directly supportive activities such as academic advising, general counseling, therapeutic counseling, discipline, vocational counseling and job placement, financial assistance and advisement, medical services, academic assistance activities, and co-curricular activities including varsity and intramural sports, social fraternities, specific interest clubs, and student government.

Right to Inspect Records

Each student has a right of access to his or her education records, with the following exceptions:

- Financial records of the student's parents.
- Confidential letters and confidential statements of recommendation placed in education records of students before January 1, 1975, provided that the letters and statements were used only for the purposes for which they were intended.
- Confidential letters of recommendation and confidential statements of recommendation which were placed in the education records of the student after January 1, 1975, in connection with admission to an institution, an application for employment, or the receipt of an honor or honorary recognition, provided that the student has waived his or her right to inspect and review those letters and statements of recommendation.
- Persons applying for admission may waive in writing their right to inspect and review confidential letters of recommendation and confidential statements of recommendation. The waiver may apply to confidential letters and statements only if the applicant or student is, upon request, notified of the names of all individuals providing the letters or statements, and such letters and statements are used solely for the purpose for which they were originally intended. The University will not require such waivers as a condition for admission or receipt of any service or benefit normally provided to students. A waiver may be revoked in writing at any time, and the revocation will apply to all subsequent recommendations.
- Education records of other students, if included on the education record of the student. The student may only inspect his/her own information.

Students wishing to review their records should submit a written request to the Office of the University Registrar, 1121 West Main Street, Suite 1200, Durham, NC 27701, or registrar@duke.edu. The request should include the following: full name, Duke student ID or Unique ID, records requested to be reviewed, purpose of review, admit term(s), Duke school/program(s), phone, and home and local addresses. The University will comply with record review requests within 45 days.

For students living locally (within commuting distance of approximately 50 miles), arrangements will be made for the student to read his or her records in the presence of a staff member. Copies are not provided, including copies of transcripts from other institutions. Other arrangements will be made for students not living locally.

A student who exercises the right to review his/her education record is also entitled to a reasonable request for explanation and interpretation of those records. If a student has made the request to review his/her record, none of those records shall be destroyed until the student's request to inspect or review has been honored.

The Provision of Academic Information to Parents and Guardians

Duke University complies with the policies set forth in the Family Educational Rights and Privacy act of 1974 concerning confidentiality, privacy, and release of information as they pertain to students’ educational records. It is primarily the responsibility of students to keep parents and guardians informed of their academic standing and progress as well as any difficulties which may affect their performance. The Office of the University Registrar does not release end-of-term or midterm grade information to parents and guardians without
students’ written permission. Suppose a student’s academic standing at the university changes, the Office of the Dean may notify parents and guardians in writing. Parents and guardians may also be alerted to the emergency and extraordinary situations which may impinge upon a student’s well-being.

**Disclosure of Personally Identifiable Information**

The University will not release personally identifiable information in education records or allow access to those records without prior consent of the student, other than information deemed “directory information.” Unless disclosure is to the student himself or herself, the consent must be written, signed and dated, and must specify the records to be disclosed and the identity of the recipient.

Prior consent may not be required for disclosure of education records to the following:

- School officials of Duke University who have been determined to have legitimate educational interests.
- Officials of other schools in which a student seeks or intends to enroll or is enrolled. Authorized representative of the Comptroller General of the U.S., the Attorney General of the U.S., the U.S. Secretary of Education, and state and local educational authorities, but only in connection with the audit or evaluation of federally supported educational programs, or in connection with the enforcement of, or compliance with, federal legal requirements relating to these programs. These officials will protect information received so as not to permit personal identification of students to outsiders, and the data shall be destroyed when no longer needed for the purposes above.
- In connection with a student’s application for, or receipt of, financial aid, but only to the extent necessary for such purposes as determining eligibility, amount, conditions, and enforcement of terms or conditions.
- State and local officials to which such information is specifically required to be reported by effective state law.
- Organizations conducting educational studies for the purpose of developing, validating, or administering predictive tests, administering student aid programs, and improving instruction. The studies shall be conducted so as not to permit personal identification of students to anyone other than representatives of the organizations, and the information will be destroyed when no longer needed for these purposes.
- Accrediting organizations for purposes necessary to carry out their functions.
- Parents of a student who is a dependent for income tax purposes (dependency must be documented).
- Appropriate parties in connection with an emergency, where knowledge of the information is necessary to protect the health or safety of the student or other individuals.
- In response to a court order or subpoena (The University will make reasonable efforts to notify the student before complying with the court order).
- A victim of an alleged perpetrator of a crime of violence or a non-forcible sex offense. This disclosure may only include the final results of the disciplinary proceeding with respect to that alleged crime or offense, regardless of the finding.
- On request, the final results of a disciplinary proceeding where a student has allegedly perpetrated a crime of violence or non-forcible sex offense and has been found to have violated University rules or policies. The names of the victims, witnesses, or other students will not be disclosed without consent.
- Parents of a student under the age of 21 who has been found with an alcohol-related disciplinary violation.

It is Duke University's practice not to provide student education record information to any party outside the institution with the exception of vendors contracted to provide a service to the institution and are considered school officials and a few entities that provide support for major Duke University events, such as commencement.

The University will maintain with the student’s education records a record for each request and each disclosure, except:

- disclosures to the student himself or herself;
- disclosures pursuant to the written consent of the student;
- disclosures to instructional or administrative officials of Duke University;
- disclosures of directory information;
- disclosures pursuant to a Federal grand jury’s subpoena or other law enforcement subpoenas where the court or other agency issuing the subpoena has ordered the institution to not disclose the existence of the subpoena.

The record of disclosure may be inspected by the student, the official custodian of the records, and other University and governmental officials.

A student wishing to suppress the release of “Directory Information” may do so by completing the Request for Non-Disclosure form. The form may be obtained by contacting the Office of the University Registrar at registrar@duke.edu. The student should weigh the implication of placing the suppression. By withholding the release of “Directory Information” Duke University will:
Duke University

- not include the student's name, address, email address, or phone number in the student directory;
- refuse to release any information about the student to the student’s insurance company, current or future employers, all forms of media, and any non-institutional persons or organizations;
- give no personal information over the phone;
- will state "do not have any documentation that would support the release of information for a student by that name" to any person/organization/company that would seek information about a student's status.

The Request for Non-Disclosure does not prevent the disclosure of information to University personnel with a legitimate educational interest.

The Request for Non-Disclosure remains in effect until the student rescinds the request. A student who wishes to revoke a Request for Non-Disclosure must complete the Request for Revocation of Non-Disclosure of Directory Information form. A request in place at the time of graduation or at the time of leaving Duke University remains in effect in perpetuity.

Right to Seek Correction of Records

A student who believes that information contained in his or her education records is incorrect, misleading, or violative of privacy or other rights may submit a written request to the Office of the University Registrar, specifying the document(s) being challenged and the basis for the complaint. The request will be sent to the custodian of the record in question. Within a reasonable period of time of receipt of the request, the University will decide whether to amend the records in accordance with the request. If the decision is to refuse to amend, the student will be so notified and will be advised of the right to a hearing.

A student request for a formal hearing must be made within 30 calendar days after the student receives notice from the record custodian that the record(s) will not be amended. The request for hearing must be made in writing to the Office of the University Registrar, signed by the student, and contain: 1) a statement that the student is requesting a formal hearing on a request to amend a record, 2) the date the student received notice from the record custodian, and the name of the record custodian, that the record would not be amended, 3) a summary of the attempts to resolve the matter with the records custodian and the result of those attempts, and 4) a summary of the evidence and arguments the student would present at a hearing.

A hearing will be held within 30 calendar days after the receipt of the student's request, and the student will be given ample advance notice of the date, place, and time of the hearing.

Conduct of the Hearing. The hearing will be conducted by a University official who does not have a direct interest in the outcome. The student will have a full and fair opportunity to present evidence relevant to the issues raised and may be assisted or represented by individuals of his or her choice at his or her own expense, including an attorney. The University official conducting the hearing will, after considering all relevant information, make a recommendation to the University Registrar.

Decision of the Hearing. Within a reasonable period of time after the conclusion of the hearing, the University will notify the student in writing of the decision. The decision will be based solely upon evidence presented at the hearing and will include a summary of the evidence and the reasons for the decision.

If the University decides that the information in the student's records is inaccurate, misleading, or otherwise in violation of the privacy or other rights of the student, the University will amend the record(s) accordingly.

If, as a result of the hearing, the University decides that the information is not inaccurate, misleading, or violative of the student's right, the student has the right to place, in his or her record, a statement commenting on the information and/or explaining any reasons for disagreeing with the University's decision. Any such explanation will be kept as part of the student's record as long as the contested portion of the record is kept and will be disclosed whenever the contested portion of the record is disclosed.

Limit to FERPA Protection of Records

FERPA's protection of personally identifiable information in a student's education record ends at the time of death.

Complaints

Complaints alleging violation of the provisions of FERPA may be submitted to:

Family Policy and Compliance Office
US Department of Education
400 Maryland Avenue SW
Washington, DC 20202-5920
1-800-872-5327
Duke’s Commitment to Diversity and Inclusion
Duke aspires to create a community built on collaboration, innovation, creativity, and belonging. Our collective success depends on the robust exchange of ideas—an exchange that is best when the rich diversity of our perspectives, backgrounds, and experiences flourishes. To achieve this exchange, it is essential that all members of the community feel secure and welcome, that the contributions of all individuals are respected, and that all voices are heard. All members of our community have a responsibility to uphold these values.

Excellence, Diversity, and Inclusion: A statement by the faculty, Provost, and President
To achieve our mission and meet the needs of a rapidly changing world, Duke strives to create a climate of collaboration, creativity, and innovation within and across disciplines. Our success depends upon the robust exchange of ideas—an exchange that flourishes best when the rich diversity of human knowledge, perspectives, and experiences is heard. We nonetheless acknowledge that our policies and practices have often failed to ensure equality of participation within our community. Our renewed commitment and responsibility to one another is articulated in the following statement.

Duke University Community Commitment
Because diversity is essential to fulfilling the university’s mission, Duke is committed to building an inclusive and diverse university community. Every student, faculty, and staff member—whatever their race, gender, age, ethnicity, cultural heritage or nationality; religious or political beliefs; sexual orientation or gender identity; or socioeconomic, veteran or ability status—has the right to inclusion, respect, agency and voice in the Duke community. Further, all members of the University community have a responsibility to uphold these values and actively foster full participation in university life.
Credit Hour Policy
For purposes of the application of this policy and accord with federal regulations,

1. A semester-course unit is the equivalent of four credit hours.
2. A "contact hour" is defined as a required time in which all students are directly engaged, as a class, in interaction with the instructor(s) of the course, synchronously or asynchronously, either in the classroom or virtually through telepresence, web-conference, or other online platforms.
3. A credit hour is expected to be a reasonable approximation of a minimum amount of student work in a Carnegie unit in accordance with commonly accepted practice in higher education.

University and Divinity Courses
Beginning Fall 1969, credit for Trinity undergraduates, Pratt undergraduates, and the Divinity School has been listed in semester-course units. One semester-course unit is equivalent to four semester hours.

1. A single semester-course unit should require a minimum of 12 hours per week of a student's time and effort, both in and outside of class, over a 15-week term, or 25 hours per week over a 7-week term.
2. All full-credit courses require a minimum number of "contact hours" totaling 150 minutes per week over 15 weeks, or 300 minutes per week over 7 weeks.

Graduate and Professional School Courses
The Graduate and Professional Schools list credit in semester hours. It is expected that the academic work required of Graduate and Professional school students will be the equivalent of:

1. Not less than one hour of classroom or direct faculty instruction and a minimum of two hours out of 15 weeks for one semester hour of credit, or the equivalent amount of work over a different amount of time, or
2. At least an equivalent amount of work as required outlined in item 1 above for other academic activities as established by the institution including laboratory work, internships, practica, studio work, and other academic work leading to the award of credit hours.

All Courses
1. When a course is offered at two levels (e.g., undergraduate and graduate), workload expectations will differ for the students enrolled at different levels.
2. Instructional units should periodically review course syllabi to determine whether the number of course units/credits is appropriate for the expected student workload.
Student Affairs & Campus Life

Student Affairs

The Division of Student Affairs is critically engaged in all aspects of undergraduate and graduate students’ lives and collaborates with students, faculty, staff, alumni, parents, and many others to deliver key services and support to students and all whom the division serves.

Student Affairs provides programs and services that support the optimal growth of Duke students; enhance their intellectual, social, cultural, and physical development; and complement Duke’s academic excellence by providing opportunities for students to experience education and explore interests beyond the classroom. For more information, visit studentaffairs.duke.edu.

Campus Life

Campus Life (studentaffairs.duke.edu/campuslife) provides education, advocacy, and support for Duke students through advising, leadership development, and experiential education. Campus Life consists of departments that work with the campus community to promote intellectual understanding, acknowledgement, and appreciation of their differences and similarities; advocate for equal access for students and student groups to participate in campus activities, including an equitable distribution of support resources for those activities; and promote a seamless integration of the academic and cocurricular sides of the university to promote a holistic, educational experience for students.

Outreach programs and services are designed to foster an equitable and engaged university community as well as a culture of broad social and civic understanding.

Campus Life Departments

Find more information about all Campus Life departments at studentaffairs.duke.edu/campuslife/campus-life-departments.

The Center for Sexual and Gender Diversity (CSGD) provides education, advocacy, support, mentoring, academic engagement, and space for lesbian, gay, bisexual, pansexual, transgender, transsexual, intersex, questioning, queer and allied students, staff, and faculty at Duke. The Center for Sexual and Gender Diversity also serves and supports Duke alumni/ae and the greater LGBTQ community.

The Center for Multicultural Affairs (CMA) offers educationally based cross-cultural programs and providing technical support on multicultural issues for the university community.

International House provides educational services, advocacy, and outreach to the international population and the Duke/Durham community.

Jewish Life at Duke works to foster and enrich Jewish life through social, educational, religious and cultural activities.

The Mary Lou Williams Center for Black Culture strives to promote racial understanding, build community, and foster an appreciation for and increase knowledge of Black people, Black history, Black culture, and the vast contributions of people of the African Diaspora.

Muslim Life at Duke is committed to enriching the lives of Muslim students and the whole campus through organizing events and activities that cater to the spiritual, social and intellectual needs of Duke students.

The University Center Activities and Events (UCAE) provides services, support, and opportunities for students to create and engage in co-curricular experiences that result in personal development, transferable skills, and meaningful connections. UCAE also provide event management expertise for groups of all sizes interested in holding events at Duke.

Women’s Center is dedicated to helping every woman at Duke become self-assured with a kind of streetwise savvy that comes from actively engaging with the world. It welcomes men and women alike who are committed to gender equity and social change.

Graduate and Professional Student Government

The Graduate and Professional Student Government of Duke University (GPSG) is the umbrella student government organization for Duke’s nine graduate and professional schools. Their purpose is to: represent and advocate on behalf of graduate and professional students at Duke University; serve as a liaison among the student governments of the graduate and professional schools of the University; serve as a liaison between graduate and professional students and the University Administration; nominate graduate and professional student representatives to University committees; program events of interest to the graduate and professional student community; and financially support the programming of graduate and professional student groups.
Visit the GPSG website at gpsg.duke.edu to find out more about graduate and professional student organizations at Duke and for information on upcoming events. Contact GPSG (gpsgexec@duke.edu) for additional details on how students can become involved.

The Black Graduate and Professional Student Association

The Black Graduate and Professional Student Association (BGPSA) represents all minority graduate and professional students on the Duke University campus. The association’s primary mission is to enhance the Duke experience for its members through community service, social, and academically based programming events. As an umbrella organization, the association welcomes students from groups including the Black & Latino MBA Organization, Black Law Students Association, Black Seminarians Union, Bouchet Society, Hurston-James Society, and Student National Medical Association. Through its academic forums, luncheons, community service initiatives, social events, and recognition ceremony the group hopes to assist in the development of future minority leadership in the Duke community and in the world.

Religious Life

In partnership with the Division of Student Affairs, the Chapel convenes, supports, and advocates for all of the officially recognized Religious Life groups on campus that serve students, including Buddhist, Catholic, Hindu, Jewish, Latter-Day Saints, Muslim, Orthodox, and Protestant organizations and groups. There are about two dozen Religious Life groups at Duke; find a listing of them at chapel.duke.edu/religiouslife.

With a mission of “bridging faith and learning,” the Chapel holds ceremonies, concerts, Christian worship services, and more. It is a sanctuary open to all people for important personal moments of prayer, reflection, grief, and gratitude. The Chapel’s Student Ministries provides opportunities for undergraduate students to hear and respond to God’s call for their lives on campus, in Durham, and beyond through study, artistic expression, counsel, service, and community. Learn more at chapel.duke.edu.

Intercollegiate Athletics

The Athletic Department fosters intercollegiate athletics by striving for excellence and by providing the best possible framework within which highly accomplished student-athletes can compete. The department has a dual responsibility to provide a high-quality athletic program and environment so that all students have the opportunity to compete to the fullest extent of their abilities. Duke is a member of the National Collegiate Athletic Association (NCAA) and the Atlantic Coast Conference (ACC).

First-year students may participate on all varsity teams. The director of athletics provides departmental leadership and coordinates all athletic policies with the University Athletic Council. The council consists of representatives from the undergraduate student body, the faculty, the administrative staff, the trustees, and the alumni. The council meets with the director of athletics periodically during the school year.
Student Health & Safety

Campus Police
It is the mission of the Duke University Police Department to protect and serve the people and property of Duke. We are guardians of a community of world class education, research and healthcare and must prevent violence, reduce fear, and build relationships. For more information, visit police.duke.edu.

Counseling & Psychological Services (CAPS)
CAPS helps Duke students enhance their strengths and learn to cope with the trials of living, growing, and learning. CAPS offers many services to Duke undergraduate, graduate, and professional students, including brief individual counseling/psychotherapy, consultation, couples and group counseling, and assistance with referrals. CAPS' staff also provide outreach education programs to student communities, promoting an empathic and supportive culture. Staff members are available for consultation with faculty concerning students or other matters relating to mental health in the university community. The CAPS staff includes psychologists, clinical social workers, and psychiatrists experienced in working with college-age adults. CAPS' staff carefully adhere to professional standards of ethics, privacy, and confidentiality. For more information, visit studentaffairs.duke.edu/caps.

DukeReach
DukeReach provides direct case management services including interventions, advocacy, referrals and follow-up services for students who are experiencing significant difficulties related to mental health, physical health, and/or psycho-social adjustment. The Assistant and Associate Deans in DukeReach coordinate student services and provide connections with campus departments as well as outside agencies and providers. For more information, visit studentaffairs.duke.edu/dukereach.

DuWell
DuWell works to enhance the educational experience for Duke students by addressing substance use and abuse issues and promoting healthy physical, emotional and social development, including issues related to sexual health. It offers one-on-one screening (for substance use) and health coaching, workshops and trainings on the different topic areas of wellness (including Social Host Education, Stress and Sexual Health workshops) and programs for student groups upon request. Consultation on prevention of high-risk behavior and promotion of wellness is available to students, faculty, professionals and staff. DuWell is dedicated to fostering a living/learning environment on campus and within the surrounding community that encourages the full development of the individual as an engaged member of the community. For more information, visit studentaffairs.duke.edu/duwell.

Student Health
Student Health Services at Duke University is jointly supported by the Division of Student Affairs and the Department of Pediatrics. The Duke Student Health Center is the primary source for a wide range of healthcare services, many of which are covered by the Student Health Fee. Its mission is to provide evidence-based, patient-centred health care to the Duke student community in a professional and compassionate manner that directly contributes to the student's well-being and overall success. For more information, visit studentaffairs.duke.edu/studenthealth.
Housing, Dining, & Transportation

Housing and Residence Life (HRL)

Undergraduate Housing

Housing, Dining and Residence Life manages all aspects of the university’s three-year undergraduate residency requirement. Residential programs are designed to build positive communities that value learning, create new opportunities for faculty engagement, and generate positive social connections. HRL, student residents and others in the Duke community develop and maintain environments that support classroom learning and encourage students to seek learning opportunities in the world around them. HRL promotes opportunities for students to connect with others and develop a strong and enduring sense of belonging; and intentionally provide opportunities for students to grow and develop as they continue to negotiate developmental issues related to identity, autonomy, and responsibility. HRL programs are rooted in the concepts of mutual respect and civility, and recognize and celebrate the dignity and self-worth of all members.

HRL also manages the facilities operations of all university student residences, which comprise approximately 25 percent of all university space. These responsibilities include all long-range planning, renovations, and major projects, managing housekeeping and maintenance efforts, and ensuring that all residence options are safe, secure, comfortable, and well-maintained. For more information, visit studentaffairs.duke.edu/hdrl.

Graduate and Professional Student Apartments

Limited on-campus housing is available to full-time graduate students. Priority for housing assignment will be awarded to graduate students who arrive from abroad on student visa status and it is their first time attending school outside of their home country. Students applying for the full academic year will be given priority in assignment. All students applying for less than the full academic year will be assigned on a space-available basis after all students applying for the full academic year have been accommodated. International students do not receive priority when applying for less than the full academic year. For more information on graduate student housing application timeline and facility amenities, visit this website. Assignments are made in the order of receipt of completed applications.

Off-Campus Housing

The Duke Community Housing Office maintains a listing of rental apartments, rooms, and houses provided by property owners or real estate agencies in Durham at durhamgradhousing.com.

Duke Housing and Residence Life (HRL) operates a website specifically to simplify the off-campus housing search for students, parents, faculty and staff, and for area property owners and managers at nearduke.com/housing.

Duke Dining

Duke is home to one of the most innovative, dynamic, and cutting edge collegiate dining programs in the country. Duke Dining provides access to over 45 dining locations that include 36 on-campus locations, Merchants-on-Points (MOPs-off-campus restaurants that deliver), and food trucks. A community-driven, sustainable, award-winning program, Duke Dining provides opportunities for culinary education and engagement with access to cooking classes, chef demos, nutrition and wellness events and special themed dinners throughout the academic year. For more information, visit studentaffairs.duke.edu/dining.

DukeCard

All Duke students are issued electronic Duke University identification cards through their mobile devices. This identification should be carried at all times. DukeCards are the means of identification for library privileges, athletic events, and other university functions or services open to them as university students. Students will be expected to present their cards on request to any university official or employee. DukeCards are not transferable and fraudulent use may result in loss of student privileges or suspension. For more information, visit dukecard.duke.edu.

Parking & Transportation

Duke Parking & Transportation provides the Duke community with parking options that balance price and convenience while managing supply and demand across the parking system. A valid permit is required in all locations; most locations are gated and the permit activates the entry and exit gates. Visitors who do not have a permit pay by the hour in facilities specially set aside for them. Accommodations are also available for patrons that require accessible parking or transportation.

Options include annual permits and short-term permits that allow for flexible or occasional parking. Anyone affiliated with Duke is
eligible to purchase on-campus parking in available locations. There are also many transportation options available at Duke, including Duke Transit (buses), vans, city and regional buses, private taxi service, and a ride-hailing program. For more information, visit parking.duke.edu.
The Student Disability Access Office (SDAO) recognizes disability as an aspect of diversity that is integral to society and to our campus community. Accessibility is an essential feature of the Duke campus, and the SDAO strives to create an inclusive community for our students. The SDAO strives to ensure that students with disabilities are provided the tools they need to fully access all aspects of student life inside and outside of the classroom.

Core Functions of SDAO

- Partner with students with disabilities to establish services for their access and inclusion on campus
- Manage, coordinate, implement and evaluate accommodation/service programs
- Serve as a resource to students/faculty/staff to ensure effective provision of services
- Provide educational and resource support to the campus community to increase awareness regarding how to create and sustain access and inclusion for students with disabilities in all aspects of the university
- Provide resource and referral information to the campus community and prospective student and their families

SDAO works with each student individually to establish academic adjustments and auxiliary aids and services, more frequently referred to as academic accommodations for the purpose of eliminating the environmental barriers impacting the student’s equitable access to the campus facilities, programs and activities.

In order to receive consideration for reasonable accommodations under Section 504 of the Rehabilitation Act of 1973, the Americans with Disabilities Act of 1990 (ADA), and the ADA Amendments Act of 2008, a student must have a physical or mental impairment that substantially limits one or more major life activities. Students requesting accommodations under the provisions of the ADA, ADA Amendments Act of 2008, and Section 504 of the Rehabilitation Act of 1973 (e.g., academic, accessibility, housing) must contact the Student Disability Access Office to explore possible coverage. Students with medical conditions not covered under the provisions of the ADA and the ADA Amendments Act may wish to contact Duke Student Health Service. Additional information and requests for accommodations may be found on the SDAO website.

For more information, visit access.duke.edu/students.
Continuing Studies

Academic Study

Admission to the Continuing Studies Program is discretionary. For consideration for admission, applicants to the Continuing Studies Program must meet at least one of the following two criteria:

- Earned bachelor’s degree from a college or university accredited by a national or regional accrediting body recognized by the Department of Education.
- Age 25 or older, and intend to initiate or complete academic study in a Duke University academic program.

Students are given academic counseling by the Office of Continuing Studies and Summer Session, and are subject the regulations set forth for degree candidates, unless explicitly noted otherwise. A junior or senior who is currently enrolled at an external college or university who wishes to pursue an academic discipline unique to Duke University, may apply through the Office of Continuing Studies for admission as a nondegree, full-time visiting student for one or two semesters. Students with unique circumstances should contact the Office of Continuing Studies.

Minimum GPA Requirement

Successful applicants are expected to have earned a minimum 3.0 GPA in their most recent program. Applicants who fail to meet the minimum GPA requirement, are subject to additional review and may be admitted on a provisional basis. As part of the additional review, the following will be taken under consideration:

- the applicant has not been enrolled as a full-time student in the last 4 years, and
- the applicant demonstrates the ability to successfully complete college level coursework by earning a passing grade (B or better) in a minimum of 4 courses during the last 2 years.

As part of a provisional admission, a student must earn a minimum 3.0 GPA in the semester immediately following the provisional admission.

Withdrawal

If a student enrolled in a Duke University program withdraws from the program, or is no longer in good academic standing, they must wait two academic terms before re-applying to any Duke program, including Continuing Studies (see the Satisfactory Continuation Requirements outlined on page 51 of the Bulletin of Undergraduate Instruction).

Semester Continuation Requirements

Semester continuation requires that you earn a passing grade (C-or better) in a minimum number of courses to remain in good standing. Students who receive at least one failing grade (D, D-, F) are subject to academic probation or academic dismissal.

| Academic Probation          | • Earned D or D-in at least one course
|                            | • Earned F in one course, and C-or better in at least two courses |
| Academic Dismissal          | • Earned F in at least one course |

Students placed on academic probation must acknowledge their probationary status in writing to the academic dean for Continuing Studies students, in order to continue into the next academic term. They are also expected to seek assistance from campus resources and have their course selection approved by their academic dean. In the probationary term they must earn grades of C or better in all courses to continue. Students who withdraw from all courses must wait two semesters to submit a request to return to study.

Program and application information is available from Duke Continuing Studies. Application deadlines: August 1 for the fall semester, December 1 for the spring semester, April 15 for Term 1 of the summer session, and June 1 for Term 2 of the summer session.

Certificate Programs

Professional certificate programs offered include human resource management, management accounting, digital media and marketing, big data and data science, technical communications, business communications, business ethics, paralegal studies, financial planning, event development, Six Sigma Green Belt, entrepreneurship, supply side management, sustainable management, online learning, finance essentials, legal nurse consulting, and others.
**Nonprofit Management Program**

Students interested in the nonprofit sector or in community development are invited to explore the noncredit course offerings of this program. Taught by experts and practitioners, these short courses offer instruction concerning financial and resource management, management of personnel and volunteers, leadership development, fundraising, planning and evaluation, board development/governance, and media relations.

**Osher Lifelong Learning Institute (OLLI) at Duke**

OLLI at Duke began in 1977 as the Duke Institute for Learning in Retirement. Since 2004, the membership organization has been a member of the Osher Lifelong Learning Network, a group of more than 120 institutes across the country dedicated to meeting the needs of older learners and extending the demographic served by traditional universities. OLLI sponsors noncredit course offerings in the fall, winter, and spring as well as fall and spring retreats, language tables, reading groups, film and lecture series, and volunteer opportunities.

**Duke Youth Programs**

For more than thirty-five years, Duke Youth Programs has offered academic enrichment opportunities for middle and high school students in the summer. Current offerings range from camps in biosciences and engineering, forensic science, game design, drones, math, cryptography, neurosciences, creative writing, SAT preparation, video production, and a college admissions boot camp.

For more information, call the Office of Continuing Studies and Summer Session at (919) 684-6259, or visit learnmore.duke.edu.
Duke University Libraries

The Duke University Libraries are the shared center of the university's intellectual life. The William R. Perkins Library, Bostock Library and Rubenstein Rare Book & Manuscript Library comprise the main West Campus library complex, which is joined by Lilly and Music libraries on East Campus, the Peasre Memorial Library at the Duke Marine Lab and the separately administered libraries serving the schools of Business, Divinity, Law and Medicine. Together they form one of the nation's top ten private university library systems.

All Libraries

- Perkins & Bostock Libraries (library.duke.edu)
- David M. Rubenstein Rare Book & Manuscript Library (library.duke.edu/rubenstein)
- Duke University Archives (library.duke.edu/rubenstein/uarchives)
- Lilly Library (library.duke.edu/lilly)
- Music Library (library.duke.edu/music)
- Marine Lab Library (library.duke.edu/marine)
- Library Service Center (library.duke.edu/lsc)
- Divinity School Library (library.divinity.duke.edu)
- Duke Kunshan University Library (dukekunshan.edu.cn/en/academics/library)
- Ford Library, Fuqua School of Business (library.fuqua.duke.edu)
- Goodson Law Library (law.duke.edu/lib)
- Medical Center Library (mclibrary.duke.edu)

University Institutes

Duke Institute for Brain Sciences (DIBS)

The Duke Institute for Brain Sciences (DIBS) provides a vibrant hub for all who share our vision of making neuroscience greater than the sum of its parts by integrating schools, disciplines, analysis and education to accelerate breakthroughs and benefit society. It is an exciting place to be! The DIBS mission is to promote interdisciplinary brain science and translate discoveries into solutions for health and society. Each year, DIBS touches thousands of people, from our 190-member Faculty Network and hundreds of students and trainees to the many who benefit from campus, community, and outreach activities. For more information, visit dibs.duke.edu.

Kenan Institute for Ethics

The Kenan Institute for Ethics is an interdisciplinary think and do tank committed to promoting moral reflection and commitment, conducting interdisciplinary research, and shaping policy and practice at Duke and beyond. From current policy debates about the ethics of migration, cyber-security, or artificial intelligence to historical interrogations of the rise of a post-secular society and nature of genocide to philosophical puzzles about the limits of individual responsibility or foundations of happiness, the Kenan Institute for Ethics takes seriously the notion that ethical questions and problems are indeed everywhere. For more information, visit kenan.ethics.duke.edu.

Duke Global Health Institute (DGHI)

Formed in 2006 as part of Duke University's commitment to spark innovation in global health research and education, the institute brings together knowledge and resources from across the university to address the most important global health issues of our time. DGHI faculty, staff and students are engaged in research and educational projects in more than 40 countries, including the United States. In several of these countries, DGHI has built longstanding, bilateral collaborations with local institutions and organizations, including Duke-affiliated partners such as Duke Kunshan University in China and the Duke-NUS Medical School in Singapore. For more information, visit globalhealth.duke.edu.

John Hope Franklin Humanities Institute (FHI)

Founded in 1999, the John Hope Franklin Humanities Institute (FHI) is built on a fundamentally collaborative model befitting the Duke University emphasis on knowledge in the service of society. Through interdisciplinary cross-fertilization, we seek to encourage the
conversations, partnerships, and collaborations that continually stimulate creative and fresh humanistic research, writing, teaching, and practice at Duke. Inspired by the scholarly and civic example of John Hope Franklin, we also support work that engages questions of race and social equity in their most profound historical and global dimensions. For more information, visit fhi.duke.edu.

The Social Science Research Institute (SSRI)
The Social Science Research Institute (SSRI) brings together researchers with interests in problems that cross the various social and behavioral sciences, including problems that connect with the humanities and natural sciences. It promotes multidisciplinary collaboration among such scholars as they work on important social issues that are challenging to address fully from within any given discipline. For more information, visit ssri.duke.edu.

The Nicholas Institute for Environmental Policy Solutions
The Nicholas Institute for Environmental Policy Solutions at Duke University improves environmental policymaking worldwide through objective, fact-based research to confront the climate crisis, clarify the economics of limiting carbon pollution, harness emerging environmental markets, put the value of nature's benefits on the balance sheet, develop adaptive water management approaches, and identify other strategies to attain community resilience.

The Nicholas Institute is part of Duke University and its wider community of world-class scholars. This unique resource allows the Nicholas Institute's team of economists, scientists, lawyers and policy experts to not only deliver timely, credible analyses to a wide variety of decision makers, but also to convene these decision makers to reach a shared understanding regarding this century's most pressing environmental problems. For more information, visit nicholasinstitute.duke.edu.

Bass Connections
Bass Connections bridges the classroom and the world beyond the university, giving students from all of Duke's schools a chance to tackle complex societal problems alongside our superb faculty. We support research teams that draw on perspectives and methods from multiple disciplines, as well as robust engagement with communities, stakeholders and decision-makers.

Named in honor of founding donors Anne T. and Robert M. Bass P'97, the program exemplifies Duke's commitment to interdisciplinary, collaborative inquiry. The Basses' $50 million gift sparked a new approach to integrating research, education and civic engagement within the university; by including a $25 million matching challenge, their donation has already inspired more than 65 donors to support this innovative program.

Through Bass Connections, Duke is channeling its unique culture of collaboration, ambitious entrepreneurial spirit and established record of applying classroom learning to pressing global problems, to create a distinctive new model for education. For more information, visit bassconnections.duke.edu.

Initiatives
Rhodes Information Initiative at Duke (iiD)
The Rhodes Information Initiative at Duke (iiD) is an interdisciplinary program designed to increase "big data" computational research and expand opportunities for student engagement in this rapidly growing field. Started in 2013, the program is led by Robert Calderbank.

Launched as an initiative of Duke University, Rhodes iiD is partnered with the Duke University Quantitative Initiative, which promote cross-pollination of ideas throughout Duke's programs and research projects, and works to increase the number of quantitative faculty in all disciplines on Duke campus. For more information, visit bigdata.duke.edu.

Innovation & Entrepreneurship Initiative (I&E)
I&E believes all Duke students benefit from learning about innovation and entrepreneurship—from those who wish to found a company, to those who want to change the world with innovation, to those who simply want to cultivate a more creative and entrepreneurial mindset.

I&E partners with schools and departments across Duke to offer interdisciplinary, experience-based education. Whether students are working on their own idea with a mentor, or advancing an exciting faculty innovation through a course, students learn via experiences that are in service of ambitious, worthy goals and offer opportunities for meaningful collaboration. For more information, visit entrepreneurship.duke.edu.
The Duke Initiative for Science & Society

The Duke Initiative for Science & Society ("Science & Society") fosters research, education, communication, democratic deliberation, and policy engagement on the ethical progress of science and technology in society. Science & Society takes an interdisciplinary approach, with a focus on applied ethics and policy, to advance the responsible use of science and technology for humanity. For more information, visit scienceandsociety.duke.edu.

MEDx

MEDx (Medicine + Engineering at Duke) was forged in 2015 to enhance existing ties and foster new interdisciplinary collaborations between the School of Medicine and Pratt School of Engineering as the first part of a Provost initiative to create opportunities at the intersection of academic units, Together Duke. An initiative rather than an institute, MEDx is structured to enhance existing ties and encourage new collaborations among faculty from both schools as well as other schools, institutes and initiatives at Duke.

MEDx fosters the exchange of ideas and creates research opportunities between physicians, engineers, computer scientists, researchers and innovators. We promote the training of the next generation of researchers and clinicians to work symbiotically on new solutions to complex clinical problems, and we develop strategic commercialization opportunities to translate research advances into effective devices, therapeutics and care delivery systems. For more information, visit medx.duke.edu.

Centers

Margolis Center for Health Policy

The Robert J. Margolis, MD, Center for Health Policy was established in January 2016 with a $16.5 million gift from Duke medical school alumnus Robert J. Margolis and his wife Lisa, through the Robert and Lisa Margolis Family Foundation. Duke-Margolis catalyzes Duke University's leading capabilities including interdisciplinary academic research and capacity for education and engagement, to inform policy making and implementation for better health and health care.

Duke-Margolis partners with funders and experts in healthcare policy and practice from around the world and is advised by an accomplished board of healthcare leaders representing academia, patients, policy research, payers, and providers. The Center has offices and staff on Duke University's campus in Durham, North Carolina and at the Duke in DC offices in the heart of the nation's capital. For more information, visit healthpolicy.duke.edu.

Duke University Center for International and Global Studies (DUCIGS)

The Duke University Center for International and Global Studies (DUCIGS) grounds its research, teaching, and programming on the deep, region and culture-specific knowledge and experience of its organizational units while exploring global topics, pursuing interdisciplinary and cross-regional collaboration, and welcoming new approaches within areas studies and global studies. The mission of DUCIGS is to:

- Support, engage, and connect researchers, students, departments, and schools to work on international issues
- Promote interdisciplinary research and education to understand and engage with challenging global issues
- Support and coordinate the activities of the area studies centers, councils, and initiatives

DUCIGS is home to various international area studies centers, councils and initiatives including:

- Africa Initiative (AI)
- Asian Pacific Studies Institute (APSII)
- Duke Brazil Initiative (DBI)
- Center for Latin American and Caribbean Studies (CLACS)
- Concilium on Southern Africa (COSA)
- Center for Slavic, Eurasian, and East European Studies (CSEEES)
- Slavic and Eurasian Languages Resource Center (SEELRC)
- Duke India Initiative (DII)
- Duke Islamic Studies Center (DISC)
- Duke University Middle East Studies Center (DUMESC)
- Global Asia Initiative (GAI)
- Observatory on Europe
Visit the DUCIGS website at igs.duke.edu to learn more about the many centers and initiatives it houses.

**Center for Documentary Studies**
The Center for Documentary Studies (CDS) at Duke University offers an interdisciplinary program in the documentary arts—photography, audio, film/video, narrative writing, new media, and other means of creative expression—that emphasizes active engagement in the world beyond the university campus. Much more than a traditional educational center, CDS encourages experiential learning in diverse environments outside the classroom, with an emphasis on the role of individual artistic expression in advancing broader societal goals. Programs range widely to include university undergraduate courses, popular summer institutes that attract students from across the country, international awards competitions, award-winning book publishing and radio programming, exhibitions of new and established artists in the center’s galleries, an international documentary film festival, nationally recognized training for community youth and adults, and fieldwork projects in the United States and abroad. For more information, visit documentarystudies.duke.edu.

**Dewitt Wallace Center for Media and Democracy**
The DeWitt Wallace Center for Media & Democracy (DWC) is Duke University’s hub for the study of journalism. DWC studies the interaction between news media and policy, supports watchdog and accountability reporting in the United States and around the world, and teaches about the media’s role in democracy. The center is part of the Sanford School of Public Policy, and shares in the Sanford School’s mission of teaching, research, and policy engagement, with the goal of putting knowledge in service to society. The center offers over twenty undergraduate courses designed to give students a thorough understanding of the principles and the practice of journalism. Together with support from Trinity College of Arts & Sciences, the center hosts the Policy Journalism and Media Studies Certificate, an undergraduate certificate program for students aspiring to become future journalists, or private and public sector leaders who will interact with the media. In addition, the center hosts the Duke Reporters’ Lab and administers the undergraduate Melcher Family Award for Excellence in Journalism. For more information, visit dewitt.sanford.duke.edu.

**DukeEngage**
DukeEngage provides fully-funded opportunities that enable students and faculty to collaborate with organizations across the globe to address critical societal needs through an immersive summer of civic engagement. Each year, Duke undergraduates work with communities on a variety of local issues while developing an understanding of their role in affecting social change and gaining a more nuanced perspective of self, purpose & place in the world. For more information, visit dukeengage.duke.edu.

**Duke Civic Engagement**
Duke Civic Engagement (DCE) strengthens and connects the ways in which Duke partners with communities. DCE supports Duke’s collaborations on pressing social challenges by increasing the capacity of the campus to sustain partnerships and sharing best practices in community engagement. DCE provides trainings, workshops, and consultations; volunteer and partnership opportunities through the ConnectCommunity platform; and a listing of community-based federal work study opportunities. In these ways, DCE aims to advance civic engagement and promote equitable approaches to strengthen partnerships between Duke and the community. For more information, visit civic.duke.edu.

**Technology Resources**

**The Office of Information Technology**
The Office of Information Technology (OIT) is responsible for computing and technology services and support for the university community. OIT’s searchable website offers access to free software, Duke-supported applications, news and training, technical support, and many other resources to help students, faculty, and staff make the most of information technology at Duke. For more information, visit oit.duke.edu.

**Computing and Networking**
All campus buildings, including residence halls, as well as the outdoor space near Bryan Center plaza, are equipped with secure high-speed wireless Internet. Residence halls are also wired for access to Duke’s network. Members of the Duke community are assigned their own email accounts, which they may access from their own computers, the web or from any mobile device using their NetID and password. For more information, visit wireless.duke.edu.

**Printing, Software, and Labs**
The ePrint system enables students to print from computers and mobile devices (using the Pharos print app) to printers distributed throughout campus. Up-to-the-minute status information for all printers is available at the ePrint status page. Dozens of software packages are available for free or at a discount through software.duke.edu. There are also several physical computer labs across campus and a growing array of virtual computer resources as well. Students can also visit specialty labs such as the Multimedia Project Studio and the three Co-Lab Studios (located at the Technology Engagement Center (TEC), the Rubenstein Arts Center, and East Campus), which house 3D printing and other fabrication tools. For more information, visit oit.duke.edu/category/printers-and-labs.

**Technology Training**

Undergraduate and graduate students can take advantage of free in-person or online training on programming, app development, web design, IT security, Adobe Creative Cloud, and more. Online training is accessed through the LinkedIn Learning online training library. The Roots training series offers in-class workshops via the Innovation Co-Lab (colab.duke.edu). For additional information on available opportunities and to sign up for a monthly newsletter, visit oit.duke.edu/training.

**Storage and Backup Services**

Duke offers services for securely storing, backing up, and recovering your personal files. Students receive 50 GB of secure cloud storage through Duke Box at box.duke.edu. Box and most Duke services are protected by Duke’s Multi-Factor Authentication (MFA) two-step verification. Enroll and set up the Duo app at oit.duke.edu/mfa.
Career Center

The Career Center, working in partnership with faculty and colleagues, provides career advising to all Duke undergraduates, graduate students, and alumni. Recognizing the unique talents and needs of each individual, the Career Center encourages students to make the most of their Duke experience by accessing relevant campus resources, developing career interests and values, and establishing and maintaining important human relationships with their peers as well as Duke faculty, staff, and alumni. The Career Center works to build and maintain relationships with alumni and employers who can provide internships and learning opportunities, entry-level positions, and opportunities for experienced professionals. For more information, visit careerhub.students.duke.edu.
Agreements with other Universities

Neighboring Universities

Under a plan of cooperation—the interinstitutional agreement among Duke University and The University of North Carolina at Chapel Hill, North Carolina State University, North Carolina Central University, The University of North Carolina at Charlotte, and The University of North Carolina at Greensboro—a student regularly enrolled in Duke University as a degree-seeking student and paying full fees may enroll for one approved course each semester at one of the institutions in the cooperative program unless an equivalent course is offered at Duke in the same academic term. Under the same conditions, one interinstitutional course per summer may be taken at a neighboring institution participating in this agreement provided that the student is concurrently enrolled at Duke for one full course credit. This agreement does not apply to contract programs such as the American Dance Festival or to study abroad programs.

Approval forms for courses to be taken at these neighboring institutions may be obtained from the offices of the academic deans and the university registrar. Forms are also available online at the Office of the University Registrar website (registrar.duke.edu), in the Registration section. Only those courses not offered at Duke will be approved. Approval must be obtained at Duke from the director of undergraduate studies of the subject of the course and the student's academic dean. Credit so earned is not defined as transfer credit since grades in courses taken under the interinstitutional agreement are entered on the official record and used in determining the grade point average. The courses may be eligible for Areas of Knowledge and Modes of Inquiry coding. The student pays any special fees required of students at the host institution.

Courses taken at The University of North Carolina at Chapel Hill by Duke students in the Robertson Scholarship Program (a joint scholarship program for students at Duke and The University of North Carolina at Chapel Hill) are interinstitutional courses. However, the restriction on the number of courses and the kind of courses (i.e., those not offered at Duke) permitted does not always apply. Robertson Scholars should refer to program materials for specific regulations.

Domestic Exchange Programs

Trinity College has exchange programs with two domestic institutions: Howard University in Washington, DC, and Spelman College in Atlanta, Georgia. Duke students may study for a semester at either institution, while students from these institutions enroll for the same period at Duke. Students may enroll in a wide variety of courses at either Howard University or Spelman College for which they will receive transfer credit at Duke. Transfer credits earned under this exchange program do not count against the maximum allowable domestic or study abroad transfer credits. For more information about these programs, visit 011 Allen.
Mission & History

The Mission of the Pratt School of Engineering

The mission of Duke’s Pratt School of Engineering is to provide a rigorous engineering education for both undergraduate and graduate students, enabling them to lead productive, rewarding, and ethical lives for the betterment of society.

The History of the Pratt School of Engineering

Duke’s Pratt School of Engineering is a vibrant teaching and research institution focused on education and exploring the frontiers of engineering in a hands-on, cross-disciplinary learning environment. A Duke engineering education is built on a foundation of partnership and shared commitment between students and faculty. Pratt students become successful leaders, and compete with the very best students in the world for prestigious scholarships and fellowships.

The mission of the Pratt School of Engineering is to provide a rigorous engineering education for students, enabling them to lead productive, rewarding, and ethical lives for the betterment of society. It is Pratt’s vision that engineering students and faculty will be catalysts for generating and integrating knowledge across the disciplines required to address complex issues facing a global society.

The school offers bachelor, master of science, and doctoral degrees majoring in biomedical engineering, civil and environmental engineering, electrical and computer engineering, mechanical engineering, and materials science. The school also offers a professional master of engineering management degree and a suite of master of engineering degrees for students who want to pursue applied engineering roles in industry.

The Pratt School of Engineering and Trinity College of Arts & Sciences are the undergraduate schools of Duke University. The Pratt School of Engineering is also one of Duke’s nine graduate and professional schools and has extensive collaboration with the School of Medicine, the Sanford School of Public Policy, Nicholas School of the Environment, School of Law, The Fuqua School of Business and The Graduate School.

The Pratt School of Engineering is located near North Carolina’s famed Research Triangle Park, named for the Triangle formed by Duke University in Durham, The University of North Carolina at Chapel Hill, and North Carolina State University in Raleigh. The 7,000-acre Research Triangle Park, recognized internationally as a center for cutting-edge research and development, is home to more than 200 organizations and more than 100,000 employees.
## Academic Calendar

### Summer 2022

<table>
<thead>
<tr>
<th>Month</th>
<th>Date(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>February</td>
<td>February 14 (M)</td>
<td>Registration begins for all summer sessions</td>
</tr>
<tr>
<td>May</td>
<td>May 11 (W)</td>
<td>Term 1 classes begin (Monday class meeting schedule is in effect on this day)</td>
</tr>
<tr>
<td>May</td>
<td>May 13 (F)</td>
<td>Drop/Add for Term 1 ends</td>
</tr>
<tr>
<td>May</td>
<td>May 30 (M)</td>
<td>Memorial Day holiday. No classes</td>
</tr>
<tr>
<td>June</td>
<td>June 17 (F)</td>
<td>Term 1 classes end</td>
</tr>
<tr>
<td>June</td>
<td>June 20 (M)</td>
<td>Juneteenth holiday. No classes</td>
</tr>
<tr>
<td>June</td>
<td>June 21 (Tu)</td>
<td>Reading period</td>
</tr>
<tr>
<td>June</td>
<td>June 22-23 (W-Th)</td>
<td>Final exams</td>
</tr>
<tr>
<td>June</td>
<td>June 27 (M)</td>
<td>Term 2 classes begin</td>
</tr>
<tr>
<td>June</td>
<td>June 29 (W)</td>
<td>Drop/Add for Term 2 ends</td>
</tr>
<tr>
<td>July</td>
<td>July 4 (M)</td>
<td>Independence Day holiday. No classes</td>
</tr>
<tr>
<td>August</td>
<td>August 4 (Th)</td>
<td>Term 2 classes end</td>
</tr>
<tr>
<td>August</td>
<td>August 5 (F)</td>
<td>Reading period</td>
</tr>
<tr>
<td>August</td>
<td>August 6-7 (Sa-Su)</td>
<td>Final exams</td>
</tr>
</tbody>
</table>

### Fall 2022

<table>
<thead>
<tr>
<th>Month</th>
<th>Date(s)</th>
<th>Event(s)</th>
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</thead>
<tbody>
<tr>
<td>August</td>
<td>August 22 (M)</td>
<td>MEM Program and MEng new graduate student orientation begins</td>
</tr>
<tr>
<td>August</td>
<td>August 23 (Tu)</td>
<td>New graduate student orientation begins</td>
</tr>
<tr>
<td>August</td>
<td>August 24 (W, 4pm)</td>
<td>Convocation for new graduate and professional school students</td>
</tr>
<tr>
<td>August</td>
<td>August 29 (M)</td>
<td>Fall semester classes begin</td>
</tr>
<tr>
<td>September</td>
<td>September 5 (M)</td>
<td>Labor Day. Classes in session</td>
</tr>
<tr>
<td>September</td>
<td>September 9 (F)</td>
<td>Drop/Add ends for fall</td>
</tr>
<tr>
<td>September</td>
<td>September 29-October 2 (Th-Su)</td>
<td>Founders’ Weekend</td>
</tr>
<tr>
<td>October</td>
<td>October 8-11 (Sa-Tu)</td>
<td>Fall break</td>
</tr>
<tr>
<td>October</td>
<td>October 24 (M)</td>
<td>Shopping carts open for Spring 2023</td>
</tr>
<tr>
<td>November</td>
<td>November 2 (W)</td>
<td>Registration begins for Spring 2023</td>
</tr>
<tr>
<td>November</td>
<td>November 23-27 (W-Su)</td>
<td>Thanksgiving recess</td>
</tr>
<tr>
<td>December</td>
<td>December 2 (F)</td>
<td>Graduate classes end</td>
</tr>
<tr>
<td>December</td>
<td>December 19 (M)</td>
<td>Final exams ends</td>
</tr>
</tbody>
</table>

### Spring 2023

<table>
<thead>
<tr>
<th>Month</th>
<th>Date(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>January 11 (W)</td>
<td>Spring semester classes begin (Monday class meeting schedule is in effect on this day)</td>
</tr>
<tr>
<td>January</td>
<td>January 16 (M)</td>
<td>Martin Luther King, Jr. Day holiday. No classes</td>
</tr>
<tr>
<td>January</td>
<td>January 25 (W)</td>
<td>Drop/Add ends for spring</td>
</tr>
<tr>
<td>February</td>
<td>February 20 (M)</td>
<td>Registration begins for Summer 2023</td>
</tr>
</tbody>
</table>
### March
- March 11-19 (Sa-Su) Spring recess
- March 27 (M) Shopping carts open for Fall 2023

### April
- April 5 (W) Registration begins for Fall 2023
- April 19 (W) Graduate classes end

### May
- May 6 (Sa) Final exams end
- May 12 (F) Commencement begins; MEM Online Hooding Ceremony
- May 13 (Sa) MEM Hooding Ceremony; MEng Hooding Ceremonies
- May 14 (Su) Graduation exercises; conferring of degrees

### Summer 2023

#### February
- February 20 (M) Registration begins for Summer 2023

#### May
- May 17 (W) Term 1 classes begin (Monday class meeting schedule is in effect on this day)
- May 19 (F) Drop/Add for Term 1 ends
- May 29 (M) Memorial Day holiday. No classes

#### June
- June 19 (M) Juneteenth holiday. No classes
- June 26 (M) Term 1 classes end
- June 27 (Tu) Reading period
- June 28-29 (W-Th) Final exams

#### July
- July 3 (M) Term 2 classes begin
- July 4 (Tu) Independence Day holiday. No classes
- July 6 (Th) Drop/Add for Term 2 ends

#### August
- August 10 (Th) Term 2 classes end
- August 11 (F) Reading period
- August 11-13 (F-Su) Final exams
Academic Integrity

The Duke Community Standard

Duke University is a community dedicated to scholarship, leadership, and service and to the principles of honesty, fairness, respect, and accountability. Citizens of this community commit to reflect upon and uphold these principles in all academic and nonacademic endeavors, and to protect and promote a culture of integrity.

To uphold the Duke Community Standard:

- I will not lie, cheat, or steal in my academic endeavors;
- I will conduct myself honorably in all my endeavors; and
- I will act if the Standard is compromised.

It is implicit that every assignment submitted was done in accordance with the Duke Community Standard.

The Reaffirmation

Upon completion of each academic assignment, students may be expected to reaffirm the above commitment by signing this statement: “I have adhered to the Duke Community Standard in completing this assignment.”

Application of the Community Standard to the Pratt School of Engineering

The Duke Community Standard encompasses both academic and nonacademic endeavors. The first part of the pledge focuses on academic endeavors and includes assignments (any work, required or volunteered, submitted for review and/or academic credit) and actions that are taken to complete assignments. It also includes activities associated with a student’s job search since the definition of lying includes “communicating untruths in order to gain an unfair academic or employment advantage.” Some of the aspects of academic endeavors as they apply to master of engineering management students are:

Group and Individual Work. Please note that in many classes there will be both group work and individual work. Students should be sure they are clear about what level of consultation or collaboration with others is allowed.

Studying from old exams, assignments and case studies. Many courses have case studies, exercises, or problems that have been used previously. Students should not use prior semesters’ work to prepare for an exam or assignment unless allowed by the instructor.

Computer laboratories, library, meeting rooms, and other shared spaces and resources. There are numerous shared resources that are available to support a student’s studies. Use these so that they will remain in good shape and equally accessible for others.

Career Service Resources. Use these so that they will remain equally accessible for others and so that the MEM/MEng Program will remain in good standing with Career Services. Abide by Career Center policies found at careerhub.students.duke.edu.

Implicit Reaffirmation. Some instructors may not require students to include the reaffirmation on every assignment. If the instructor does not require students to write the reaffirmation (“I have adhered to the Duke Community Standard in completing this assignment”) or it is omitted from the assignment, it is implicit that every assignment submitted was done in accordance with the Duke Community Standard.

The second part of the Duke Community Standard extends its reach to nonacademic activities undertaken while enrolled as a student. Students are expected:

- to observe all local, state, and federal laws and
- to abide by Duke policies including university policies on discrimination, harassment (including sexual violence and other forms of sexual misconduct), domestic violence, dating violence, and stalking. Details for these may be found at oie.duke.edu/knowledge-base/policies-statements-and-procedures and https://studentaffairs.duke.edu/conduct/z-policies/student-sexual-misconduct-policy-dukes-commitment-title-ix.

Jurisdiction

- Program leaders may respond to any complaint of behavior that occurred within a student’s involvement in the academic program, from application to graduation. However, complaints of discrimination, harassment (including sexual harassment which, in turn, includes sexual violence and other forms of sexual misconduct), domestic violence, and stalking will be
addressed under the Student Sexual Misconduct Policy (for misconduct by students) or the Policy on Prohibited Discrimination, Harassment, and Related Misconduct (for misconduct by employees or others).

- Any student is subject to disciplinary action. This includes students who have matriculated to, are currently enrolled in, are on leave from, or have been readmitted (following a dismissal) to programs of the university.
- With the agreement of the vice president for student affairs and the dean of the Pratt School of Engineering, jurisdiction may be extended to a student who has graduated and is alleged to have committed a violation during their career.

The university reserves the right to take necessary and appropriate action to protect the safety and well-being of the campus community. Such action may include pursuing any violation of local, state or federal law, or university policy—on or off campus—that constitutes a direct or indirect threat to the university community. Further, students who are cited, arrested, or reported for repeated behavioral concerns off campus may be subject to disciplinary action. Additionally, students or groups who are on university-affiliated programs/outings may be subject to disciplinary action.

In cases of alleged policy violations by a student enrolled in a joint degree program or interdisciplinary coursework within Duke, each school or unit (the home unit and the host unit) may have a stake in the adjudication. Thus, an ad hoc process shall be developed and an ad hoc panel formed with representatives from both institutions/units to handle the case. The sanctions may be different for each school or unit.

For students completing interinstitutional coursework at other institutions, whether domestic or international, or for visiting students enrolled in classes at Duke, the home and the host institutions should confer and decide the process to be followed, which may include combined or separate elements. The sanction may be different for each institution.

**Academic Standard Resolution Process**

A flow chart for the resolution process for possible violations of the academic standard is given in Figure 1 (see above). The details for the process will be described in this section.

**Students’ Obligation to Act on Potential Cases of Academic Dishonesty**

The Duke Community Standard stresses the commitment that students share with faculty and administrators to enhance the climate for academic integrity at Duke University. The pledge beginning "I will not lie, cheat, or steal in my academic endeavors" is followed by "I will act if the standard is compromised." Both statements, like the Duke Community Standard as a whole, are statements of principles. From principles flow policies. Stemming from this nontoleration statement ("I will act if the standard is compromised") is a policy that reflects an emphasis on taking constructive action of some sort if one witnesses or knows about dishonorable behavior connected to classroom assignments or activities.

Students who observe or hear about cheating are obligated to do something about it rather than to remain passive bystanders. They are obligated to take action. Several possible courses of action are available, and students should feel free to discuss them with trusted advisors before choosing among them:

- Alerting the faculty member that cheating may be occurring in the course. This alert can be in any form, including anonymously. The information will allow the instructor to consider corrective measures and to address the topic with the class.
Duke University

- Calling attention to the suspected violation as it is occurring, in either a public or a private manner.
- Identifying the suspected cheater to the faculty member of the course.
- Speaking directly with the student suspected of violating the Duke Community Standard, either to gain clarity about what happened or to put the person on alert that their behavior could have serious consequences; and
- Discuss concerns about a suspected violation with the executive director of the Master of Engineering Management Program or associate dean of the master’s program

Unless required otherwise by a court of law, the report will be treated in total confidence: if the reporting student requests anonymity, the faculty member will not divulge the reporting student’s name to anyone, and the reporting student is under no obligation to take the information any place else. The faculty member will then act on this information, as the Faculty Handbook requires; at the very least, the instructor will let the suspected student know that their behavior has raised suspicion. Whatever the option chosen for reporting breaches of academic integrity, a student is responsible for doing something. This responsibility is an integral part of the Duke Community Standard and will help to build a community of honor whose values the Duke Community Standard articulates.

Investigating

Once a suspected violation has been brought to the attention of the associate dean of master’s program, they may consult with the associate dean for student conduct to decide whether any further investigation is warranted and possible. They will also assess the severity of the allegations and the associate dean of master’s program will review the disciplinary record of the person suspected to see if there are any previous violations that would preclude a “one-time faculty/student resolution” if there is to be a further investigation, the associate dean of master’s program will notify the individual/group that an academic investigation is being held and specify the university policy that is suspected of being violated. The associate dean of master’s program will gather information regarding the alleged incident in order to determine the appropriate means of resolution. Investigations may include a review of related documents, interviews, or requests for written statements from any person involved in the alleged incident. Please be aware that students and organizations that lie during the investigation phase or any other aspect of the judicial process are violating the Duke Community Standard. Additionally, sanctions for multiple infractions are typically more severe than sanctions for single infractions.

Cases may be dropped for insufficient information, or referred for possible disciplinary action. In order for a case to be referred for possible disciplinary action, there must be sufficient information to believe that a policy violation may have occurred and that the alleged individual/group may be responsible.

Resolving Violations

Suspected violations are resolved dependent on their severity and the student’s disciplinary history.

One-Time Student-Faculty Resolution. When the suspected violation is “minimal,” such that it would not put the student at risk of suspension or expulsion (e.g., inadvertent omission of a citation or improper citation, minor misunderstanding about collaboration or use of materials on an assignment), and when the student has not committed any previous violations, it may be possible to resolve the situation at the level of the faculty member in charge of the course and the student. The first, and essential, stage in this process is for the faculty member to discuss the situation with the associate dean of master’s program to determine if the suspected violation is in fact “minimal,” and if the student has previously been found responsible for any academic integrity violations. The associate dean of master’s program in consultation with the associate dean for student conduct serves as a “clearinghouse” for Duke Community Standard violations, so that

- there is consistency in defining what violations are “minimal”; 
- the consequences for various types of violations are consistent; and
- repeated violations by the same student in different courses do not go unnoticed.

When these conditions for a “one-time student-faculty resolution” are met, the instructor may impose consequences for the violation and inform the associate dean of master’s program of the consequences. These could include receiving failing grades on the assignment or the course, repeating one or more assignments, and/or completing a separate assignment intended to inform the student about academic integrity (e.g., a paper analyzing the consequences of failure to cite sources properly).

If the instructor does not want to use this option, they may request an administrative hearing. If the student does not agree with the resolution proposed by the instructor, they may request an administrative hearing.

Administrative Hearing. If the suspected violation is not “minimal,” if there have been previous violations, if the instructor chooses not to resolve the case, or if the student disagrees with the instructor’s proposed resolution, the case goes to an administrative hearing. If the violation is severe enough to put the student at risk of suspension or dismissal, and if the accused student denies the accusation, they may ask to bypass the administrative hearing level and go directly to an ad hoc judicial panel, as explained below.
If the student admits violating the policy and accepts responsibility for their actions, the associate dean of master's program, in consultation with the associate dean for student conduct, will recommend the appropriate disciplinary action. Consequences may include probation, suspension, or expulsion, and/or assignments intended to educate the student about academic standards. Consequences may include recommendations to the course instructor involving grades for one or more assignments or for the whole course, but final authority for these rests with the instructor. If the student believes the administrative hearing failed to consider relevant information, violated fair procedures in some other way, or imposed consequences inappropriate to the offense, they may appeal the decision to an ad hoc student conduct panel. If the student does not admit violating the policy, the case will be presented to an ad hoc student conduct panel.

Ad Hoc Student Conduct Panel. Appeals from the administrative hearing stage will be heard by an ad hoc student conduct panel composed of four members, two students and two faculty or staff members from the Pratt School of Engineering. The associate dean of master's program will be present to help maintain continuity and consistency of procedures, but will not be a voting member of that panel. The student members will be selected by the MEM/MEng Graduate and Professional Student Government representative(s). If no representatives have yet been elected, the students will be selected by the associate dean of master's program. The faculty/staff members will be selected by the associate dean of master's program. The student suspected of the violation may object in writing if they believe any member of the proposed panel has a conflict of interest that could jeopardize a fair judgment. All members of the panel and the accused student should be notified at least forty-eight hours in advance when and where the hearing will be and what evidence will be presented. Any of the student conduct panel members or the student may ask for evidence to be presented. The accused student may consult others for advice at their discretion and may bring a member of the Duke community (student, faculty, or staff member) to the hearing as an advisor (but the advisor does not speak to the student conduct panel or any witnesses). The panel will attempt to decide, using a clear and convincing standard, whether a violation took place and what the consequences should be by consensus; where consensus is not possible, a vote will determine the outcome (thus, a 3-1 or 4-0 vote is necessary to reach a conclusion). Consequences may include probation, suspension, or expulsion, and/or assignments intended to educate the student about academic standards. Consequences may include recommendations to the course instructor involving grades for one or more assignments or for the whole course, but final authority for these rests with the instructor.

Ad hoc student conduct panels are not trials and are not constrained by rules of procedure and evidence typically used in a court of law. The university disciplinary system operates under a standard of fairness, which includes an opportunity for the student/group to be notified of the alleged incident and policy violations under consideration and an opportunity to be heard. If the student believes the ad hoc student conduct panel failed to consider relevant information, violated fair procedures in some other way, or imposed consequences inappropriate to the offense, they may appeal the decision to the associate dean for research and infrastructure. This appeal must be made within seven days of the ad hoc student conduct panel’s decision.

Nonacademic Standard Resolution Process
A flow chart for the resolution process for possible violations of the nonacademic standard is given in Figure 2 (see above). The details for the process will be described in this section.

Investigating. Once a suspected violation has been brought to the attention of the associate dean of master’s program, they will consult with the associate dean for student conduct to decide whether any further investigation is warranted and possible. (Again, allegations of harassment will be handled under either the Student Sexual Misconduct Policy or the Policy on Prohibited Discrimination, Harassment, and Related Misconduct.) If there is to be a further investigation, the associate dean of master’s program, will notify the individual/group that an investigation is being held and specify the university policy that is suspected of being violated. They will gather information regarding the alleged incident in order to determine the appropriate means of resolution. Investigations may include a review of related documents, interviews, or requests for written statements from any person involved in the alleged incident. Please be aware that students and organizations that lie during the investigation phase or any other aspect of the process are violating the Duke Community Standard. Additionally, sanctions for multiple infractions are typically more severe than sanctions for single infractions.
In cases where local, state, and/or federal laws may have been violated, the investigation may be postponed until the outcome of the legal investigation has been completed. Additionally, prior to investigation and resolution, interim restrictions may be placed on a student/group to protect the health and safety of students or the community. These restrictions may include a “no contact order,” removal of privileges, removal from or relocation within the residential community, suspension of activity, or suspension from the university. An interim suspension from the university may be imposed by the dean of the Pratt School of Engineering or the vice president for student affairs, or designee, and shall become effective immediately without prior notice whenever there is evidence that the continued presence of the student may pose a substantial and immediate threat to themselves, to others, or to the university community.

Cases may be dropped for insufficient information, or referred for possible disciplinary action. In order for a case to be referred for possible disciplinary action, there must be sufficient information to believe that a policy violation may have occurred and that the alleged individual/group may be responsible.

**Resolving Violations.** Alleged nonacademic violations are handled by administrative hearing. If the student admits violating the policy and accepts responsibility for their actions, the associate dean of master’s program will recommend the appropriate disciplinary action. Consequences may include probation, suspension, or expulsion, and/or assignments intended to educate the student about appropriate community behavior.

If the student believes the administrative hearing failed to consider relevant information, violated fair procedures in some other way, or imposed consequences inappropriate to the offense, they may appeal the decision to the associate dean for research and infrastructure. This appeal must be made within seven days of the administrative hearing’s decision.

**Confidentiality**

Information gathered in the process of resolving alleged Duke Community Standard violations is confidential. Information may be shared with the following entities or under the following circumstances:

- with the accused student to inform them that they have been accused
- with school officials with legitimate interest, such as, instructor of the class, administrators, Office of Student Affairs, Office of Student Conduct, Office of Institutional Equity
- to comply with a judicial order or lawfully issued subpoena
- to appropriate officials in cases of health and safety emergencies
- for any students involved in a joint-degree program or interdisciplinary coursework, with the other degree program
- for student involved in interinstitutional coursework, with the other institution

Information about Duke Community Standard violations, their disposition and consequences may be shared, with any identifying information removed, for the purposes of

- educating students and faculty about Duke Community Standard violations;
- ensuring consistency in responding to Duke Community Standard violations; and
- reporting on Duke Community Standard violations to the university or to facilitate research on academic integrity.
Administration

Pratt Administration

Jerome Lynch, PhD, F.EMI, Dean

Jeffrey T. Glass, PhD Senior Associate Dean for Education and Learning Innovation & Director of Engineering Management and Entrepreneurship

Rebecca Dupre, Associate Dean for Finance and Administration

Nan Jokerst, PhD, Associate Dean for Faculty Affairs and Community Engagement

Linda Franzoni, PhD, Associate Dean for Undergraduate Education

Bradley A. Fox, PhD, Associate Dean for Master’s Education

Claudia Gunsch, PhD, Associate Dean for Research and Infrastructure

Aaron Franklin, Associate Dean for PhD Education

Joseph Izatt, PhD, Interim Chair, Department of Biomedical Engineering

Henri Gavin, PhD, Chair, Department of Civil and Environmental Engineering

Helen Li, PhD, Chair, Department of Electrical and Computer Engineering

Catherine Brinson, PhD, Chair, Thomas Lord Department of Mechanical Engineering and Materials Science

Pratt School of Engineering Faculty

Duke Engineering faculty rank among the top in the nation in scholarly research productivity. Click here to view full profiles of faculty.
Student Resources

Career Services
The Duke Engineering Master’s Career Services team and the Duke Career Center offer a wide range of outstanding career support to all engineering master’s students. The aim of Career Services is to help students realize their professional goals while transitioning from Duke into the workplace. Services offered to students include career coaching, content and tools to support student job searches, events for instruction and employer connection, and proactive communication. For more information, visit careerhub.students.duke.edu/channels/engineering-masters.

Graduate Communications Center
The Duke Engineering Graduate Communications Center (GCC) is a comprehensive communications and intercultural resource and support center for all engineering graduate students. Serving international and domestic students, the GCC offers individual and small-group coaching by appointment. The Graduate Communications and Intercultural Programs (GCIP) team also organizes workshops and semester-long courses. To make an appointment with a consultant or learn about other services, visit the GCIP website at pratt.duke.edu/grad/students/comms-intercultural-programs.

Graduate Student Groups
There are many ways to get involved, make a difference, and connect with fellow students at the Pratt School of Engineering. Pratt has many different student groups that exist within departments, as well as the Engineering Master’s Student Council, Engineering Master’s Programs Students Clubs, and Engineering Graduate Student Council, which span across all programs and departments. Additionally, the Graduate and Professional Student Government connects and advocates for all of Duke’s graduate and professional students. Students who are interested in learning more about how to get involved should email pratt-masters-studentservices@duke.edu.

MEM Program Development Committee
MEM Program Development Committee members work with the program’s leaders to plan student activities, coordinate student recruitment events, and enhance industry relations. Typical social activities have included International Foods Night, Community Service Days, Basketball Campout, Graduate School Mixer, Movie Nights, and Sport Competitions.

Student Engagement and Support
The Duke Engineering Master’s Student Engagement and Support (SES) team provides community building and support opportunities to all engineering master’s students. The SES team oversees the Engineering Master’s Student Council, Engineering Master’s Student Clubs, and supports students individually with a variety of personal needs. From onboarding and new student orientation all the way through graduation, the SES encourages students to get involved in the engineering master’s experience. The SES team also has a broad set of supports and resources available to assist students with a variety of personal and professional needs. To contact SES, email pratt-masters-studentservices@duke.edu.
Admissions

Application Requirements

Applications are accepted for the fall semester only for most programs. The MEM online program accepts applicants for fall and spring semester.

Admission requires the following:

- a bachelor's degree in engineering, science, or a related field from an accredited institution (transcripts required, including an estimated GPA)*
- short answer essays*
- résumé*
- three recommendations*
- Graduate Record Exam (GRE) results or equivalent**
- Test of English as a Foreign Language (TOEFL) the International English Language Testing System (IELTS) exam, or Duolingo English Test results (international applicants only)
- a nonrefundable application fee of $75 USD to be paid via credit card*
- a video introduction*
- an interview (MEM only)

For more information on the application requirements, see the MEM and/or MEng websites.

*Items that can be submitted online using the online application.

**Submitting GRE results is optional for the 2022-2023 academic year.

International Applicants

Unlike many schools, Duke does not require financial support documents as part of the application; instead, students submit this information after they have been admitted and are enrolled in the program.

Duke does not automatically issue I-20s/DS-2019s to students upon admission. Instead, students work with the admissions office to submit information and supporting documents to Duke’s Visa Services Office.

Upon accepting the offer of admission, a student will receive an email from the admissions office with credentials to commence the visa process.

Application Deadlines

Applications are reviewed in rounds, and applicants should submit their application materials as early as possible but before the deadlines listed on the MEM and/or MEng websites.

An application is not considered complete until every component has been received, and an application must be complete by a round’s deadline in order to be considered for that round. Please note:

- In some cases, a program may postpone a decision to the next round.
- Admitted students may request to defer admission for up to one year.

Admission Revocation

The Pratt Professional School reserves the right to rescind any applicant’s admission to the program if new information arises pertaining to significant academic performance issues, criminal activity, Duke Community Standard violations, or other extraordinary circumstances. In general, significant issues that justify withdrawing an offer of admission would be those that could lead to a suspension or dismissal if a student were already enrolled in the MEM or MEng programs.

Decisions to revoke admissions will be made by the MEM or MEng Program Admissions Committee, and appeals will be heard by the Senior Associate Dean for Education and Learning Innovation.
Duke University MEM & MEng Tuition & Fees

Tuition for the 2022-2023 academic year is $30,636 (MEM) or $30,250 (MEng) per semester taken at the university. In general, completion of the eight required program courses would result in a total tuition cost of $61,272 for MEM students. For MEng students, completion of the 30.0 required credits over three semesters would result in a total tuition cost of $90,750.

Part-time MEM campus students and students in standalone graduate certificate programs pay $2,553 by course unit. Part-time MEng campus students pay $3,025 by course unit.

Estimated Full-Time Student Expenses for the 2022-2023 Academic Year

<table>
<thead>
<tr>
<th></th>
<th>MEM ON-CAMPUS</th>
<th>MEM ONLINE STUDENTS</th>
<th>MENG ON-CAMPUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuition</td>
<td>$61,272</td>
<td>$61,272</td>
<td>$60,500</td>
</tr>
<tr>
<td></td>
<td>($30,636/semester)</td>
<td>($30,636/semester)</td>
<td>($30,250/semester)</td>
</tr>
<tr>
<td>Health Fee</td>
<td>$900*</td>
<td>-</td>
<td>$900*</td>
</tr>
<tr>
<td>Health Insurance</td>
<td>$3,785**</td>
<td>-</td>
<td>$3,785**</td>
</tr>
<tr>
<td>Graduate Student Activity Fee</td>
<td>$37</td>
<td>-</td>
<td>$37</td>
</tr>
<tr>
<td>Graduate and Professional Student Services</td>
<td>$22</td>
<td>-</td>
<td>$22</td>
</tr>
<tr>
<td>Transcript Fee (one-time fee)</td>
<td>$120*</td>
<td>$120*</td>
<td>$120*</td>
</tr>
<tr>
<td>Recreation Fee</td>
<td>$342</td>
<td>-</td>
<td>$342</td>
</tr>
<tr>
<td>Room</td>
<td>$10,440*</td>
<td>$3,810 ($1,270 residency)</td>
<td>$10,440*</td>
</tr>
<tr>
<td>Board</td>
<td>$3,555*</td>
<td>-</td>
<td>$3,555*</td>
</tr>
<tr>
<td>Books</td>
<td>$668*</td>
<td>$668*</td>
<td>$668*</td>
</tr>
<tr>
<td>Transportation and Miscellaneous</td>
<td>$5,634*</td>
<td>-</td>
<td>$5,634*</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$86,775</td>
<td>$65,870</td>
<td>$86,003</td>
</tr>
</tbody>
</table>

*Fees and estimates subject to confirmation each May.

**Required unless a student can show proof of comparable private insurance coverage.

The cost of living—which includes room, board, and transportation, among other miscellaneous costs—is estimated for the academic year. The actual cost of living depends on individual lifestyle. Cost may also differ for international students.

Audit Fees

Auditors are permitted on a space-available basis with the consent of the instructor. Students charged tuition on a per-semester basis may audit courses without charge. Students who have selected the pay-per-unit billing option may audit courses but will incur a $535 fee for each audited course.

MEM-Specific Information

- The normal program duration is one year of study (two semesters).
- The normal load is four courses (12.0 units) per semester.
- Duke MEM Online tuition for the 2022-2023 academic year is $7,659 per course taken at the university. Students generally take two courses per semester over four semesters. Details for tuition, fees, and estimated expenses can be found at memp.pratt.duke.edu/online/tuition-financial-aid.
- No tuition is charged for the internship course, internship assessment course, or seminar series.
- There is no charge for registration for students in the Master of Engineering Management Program. Domestic students can estimate $455 in loan fees per semester if securing student loans.

MEng-Specific Information

- The normal program duration is one and one-half years of study (three semesters).
- The normal load is four courses (12.0 units) per semester in the first year.
- There is no charge for registration for students in the Master of Engineering Program. Domestic students can estimate $455 in loan fees per term if securing student loans.
Tuition & Fees

Tuition Policies

Payment of Accounts
The Office of the Bursar will issue invoices to registered students for tuition, fees, and other charges approximately four to six weeks prior to the beginning of classes each semester. The total amount due on the invoice is payable by the invoice late payment date which is normally one week prior to the beginning of classes. A student is required to pay all invoices as presented and will be in default if the total amount is not paid in full by the due date. A student in default will not be allowed to receive a transcript of academic records or receive a diploma at graduation. Inquiries regarding statements can be directed to the bursar’s office at bursar@duke.edu or (919) 684-3531.

Payment of Accounts for Fall and Spring
As part of the admission agreement to Duke University, students are required to pay all statements as presented. If full payment is not received, a late payment penalty charge on the past due amount is charged on the subsequent statement. The past due amount is defined as the amount due from the previous statement minus payments, financial aid, loans, and other credits received prior to the due date listed on the prior statement. Failure to receive an invoice does not warrant exemption from the payment of tuition and fees nor from the penalties and restrictions. Nonregistered students will be required to make payment for tuition, fees, and other charges at the time of registration.

In addition to late payment charges, students with accounts in default may be subject to the following restrictions:

- blocked from registering for future terms
- blocked from access to copies of transcript of academic records
- not able to have academic credits certified
- not be permitted to go on leave of absence
- not eligible to receive a diploma at graduation
- subject to withdrawal from the university
- subject to having the past due student account referred to a collection agency and credit bureaus

Refunds for Withdrawal from School during Fall and Spring Semesters
In the event of death, refund of full tuition and fees for the term will be granted. In all other cases of withdrawal from the university, students may have tuition refunded according to the following schedule:

<table>
<thead>
<tr>
<th>TIME OF WITHDRAWAL</th>
<th>REFUND AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>withdrawal before classes begin</td>
<td>100% (including fees)</td>
</tr>
<tr>
<td>withdrawal during the first or second week of classes</td>
<td>80%*</td>
</tr>
<tr>
<td>withdrawal during the third, fourth, or fifth week of classes</td>
<td>60%*</td>
</tr>
<tr>
<td>withdrawal during the sixth week of classes</td>
<td>20%*</td>
</tr>
<tr>
<td>withdrawal after the sixth week</td>
<td>No refund</td>
</tr>
</tbody>
</table>

*Fees are not refunded after the start of the term

Tuition charges paid from grants or loans will be restored to those funds on the same pro rata basis and will not be refunded or carried forward.

MEM-Specific Tuition Policies
Students enrolled in the MEM Program as full-time residential students will automatically be set up on a pay-per-semester billing system, meaning they will be charged the equivalent of four separate courses, in their first two semesters of enrollment. In the third semester, residential students will not incur tuition charges, but will be charged fees. Residential students who continue into a fourth semester will be charged tuition at a per-unit rate, including all student fees.
Students enrolling in the MEM Online Program will be set up for pay-per-semester billing at the start of each semester; however, they will be charged the equivalent of two separate courses. Students in the MEM Online Program may take three tuition-bearing courses in a semester and only pay the cost of two courses under the pay-per-semester billing option if they have already completed and paid the cost of four courses. MEM Online students may take a maximum of two free courses throughout the program.

Students enrolling as part-time will automatically be set up for payments on a per-unit basis. If an enrolling student intends to take less than the typical load (four courses for full-time, two courses for MEM Online), contact the student records coordinator to make this change. The last day for making changes to a student's billing structure is the last day of Drop/Add in that semester. Part-time campus students pay at $2,553 by course unit throughout the program.

Students should contact the student records coordinator to alter their payment structure after the start of the program. Students must pay at least the full tuition amount for the program. For example, a student may not take five courses in term one on a semester-based plan and then take three courses in the following term on a per-unit basis.

MEng-Specific Tuition Policies
Tuition is charged on a per-semester basis. Students who decide to complete the MEng Program in four semesters will be changed to part-time students in their fourth semester, and tuition will then be charged on a per-unit basis. These fourth semester students do not have to be enrolled in a full course load but must be enrolled in at least three units. Students enrolling as part-time for the duration of the program may request tuition payment on a per-unit basis. Students enrolling as full-time may not request payment on a per-unit basis until the fourth semester, as stated above.

Duke Kunshan University Tuition & Fees
Program tuition for the 2022-2023 academic year is $30,250 per semester taken at Duke Kunshan University and at Duke University. Students enrolled in the Duke Kunshan MEng program may not enroll in a part-time course load while studying at Duke University.

Students pay Duke Kunshan tuition and fees for the first two semesters of enrollment, and Duke University tuition and fees for their third and fourth terms of enrollment.

Estimated Cost of Attendance for the 2022-2023 Academic Year

<table>
<thead>
<tr>
<th></th>
<th>INTERNATIONAL STUDENTS</th>
<th>PRC STUDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuition</td>
<td>$60,500 ($30,250/semester)</td>
<td>¥180,000 (¥90,000/semester)</td>
</tr>
<tr>
<td>Health Insurance</td>
<td>$1,517</td>
<td>¥793</td>
</tr>
<tr>
<td>Books &amp; Supplies</td>
<td>$632</td>
<td>¥4,032</td>
</tr>
<tr>
<td>Residence</td>
<td>$2,978</td>
<td>¥19,000</td>
</tr>
<tr>
<td>Board</td>
<td>$2,962</td>
<td>¥18,900</td>
</tr>
<tr>
<td>Domestic/International Travel</td>
<td>$3,000</td>
<td>¥2,000</td>
</tr>
<tr>
<td>Transportation and Misc.</td>
<td>$1,880</td>
<td>¥12,000</td>
</tr>
<tr>
<td>Total</td>
<td>$73,469</td>
<td>¥236,725</td>
</tr>
</tbody>
</table>

- The normal program duration is two years of study (four semesters).
- The normal load is three courses per semester in the first year.
- Duke Kunshan student residence and dining facilities are closed during the winter break between the fall and spring semesters and for seven days during the Chinese New Year Holiday.
- International travel includes an estimate of the cost of one roundtrip from an international destination to Shanghai for international students, typical visa costs, and in the case of additional health check and registration costs associated with establishing legal residence in China for non-Chinese students. Students wishing to return to their home countries during breaks in their study before the end of the year should budget additional funds for these trips.
- Domestic travel includes two return trips (RMB ¥1,000 each) for PRC students to go back home during Chinese vacation.
- For detailed information about insurance, please contact campushealth@dku.edu.cn to fill in and submit the Medical Self-Disclosure Form. International students are required to purchase and enroll in the Health Insurance Plan (including SOS) from the university.
- All students must pay a refundable Campus Deposit of RMB ¥2,000/USD $300. The deposit would be used to pay for the costs of replacement of lost Duke Kunshan cards, repairs of residence damages, excessive cleaning, library overdue, damaged or lost...
books, replacement processing fees, other similar losses, and damages caused to university properties, transcript processing fee, refrigerator rental, and other miscellaneous charges.
Financial Aid

Because Pratt offers professional degrees rather than research degrees, most students pay their own tuition costs.

Loans

US citizens and eligible noncitizens are able to borrow through the Federal Stafford Loan Program. Applicants for assistance through this program must file a Free Application for Federal Student Aid (FAFSA), which may be completed online at studentaid.gov/h/apply-for-aid/fafsa. When completing the online form, students will be asked for Duke’s Title IV Code; it is E00165.

Maximum eligibility under the Stafford Unsubsidized Loan Program is $20,500 per year with an aggregate limit of $138,500. For further information on the FAFSA and the US Department of Education’s Stafford Loan Program, please call (800) 433-3243. Students awarded Federal loans must make satisfactory academic progress toward their degree and must be enrolled in 9 graduate-level credits per semester.

International applicants are not eligible for federal loans; however, many international students take out loans in their home countries, and some US banks may offer loans to international students for study in the United States. Duke maintains information on lenders for US citizens, permanent residents, and non-US citizens.

Scholarship

The MEng Program has limited financial aid available to highly qualified candidates through academic scholarships with an emphasis on increasing diversity within the program.

The MEM Program has limited financial assistance available through the following scholarships:

- scholarships for underrepresented students
- Wilkinson and Garda Scholarships for Outstanding Students

See memp.pratt.duke.edu/campus/tuition-financial-aid for more information on scholarships.

DoD SMART Scholarship Program (US Citizens Only)

The Science, Mathematics and Research for Transformation (SMART) Scholarship for Service Program has been established by the Department of Defense (DoD) to support undergraduate and graduate students pursuing degrees in Science, Technology, Engineering and Mathematics (STEM) disciplines. The program aims to increase the number of civilian scientists and engineers working at DoD laboratories. See smartscholarship.org/smart for more information.

VA Benefits

Duke University offers information for veterans who are applying for VA benefits, including the Yellow Ribbon Program. See registrar.duke.edu/veterans/veterans-education-benefits for more information.

On-Campus Work

While enrolled in the program, many students work in a variety of places, such as campus libraries, and various departments within Duke University. Teaching assistantships are available in various departments, and some departments have research assistantships as well. These positions are paid an hourly rate, and most students work between ten and twenty hours per week. Some positions are generally posted and filled just a week or two before classes begin each semester. See duke.studentemployment.ngwebsolutions.com for more information.
Master of Engineering Management Academic Policies

The Pratt School of Engineering at Duke University offers an interdisciplinary Master of Engineering Management (MEM) degree in cooperation with The Fuqua School of Business and the Duke University School of Law. Designed to develop engineering leaders of consequence for technology-based organizations, the degree provides a personalized, applied engineering management curriculum to a select group of high-potential students with science and engineering backgrounds.

Duke’s MEM Program was launched in 1997 out of recognition that society needs engineers with business skills. This is consistent with current interest to develop “T-shaped” individuals with focused expertise in a technical area of interest (the stem of the T) and breadth of workplace skills, such as business acumen and leadership (the top of the T). To address complex societal grand challenges, it is imperative that engineers have the interdisciplinary perspective to understand not only technological challenges, but also the environmental, societal, and fiscal implications of engineering design decisions.

In addition to the campus program, Duke offers an online education program for working professionals, known as the MEM Online Program. This program combines three week-long residencies with semester-based online coursework that allows students to work and attend school simultaneously. The online courses are accessible via the web and allow a student to participate synchronously or asynchronously according to their needs and schedule. In addition to the course content, these integrated courses allow students to learn effective skills for working productively with others from a distance.

In summary, Duke’s interdisciplinary Master of Engineering Management Program produces leaders of consequence—graduates with “T-Shaped” skill sets encompassing a solid business foundation and focused technical expertise. Perhaps more importantly, they have developed the ability to think critically and creatively, enabling them to use that expertise to make a profound impact on society.

Academic Freedom

Freedom of inquiry and the free exchange of ideas are essential for the fulfillment of the university’s mission. Academic freedom is a right and responsibility of students as well as faculty. Students who believe that their academic freedom has been abridged should submit a written complaint to the faculty director of the MEM Program. The faculty director of the MEM Program may enlist the associate dean for faculty affairs and community engagement to provide advice. Cases not resolved by the faculty director of the MEM Program may be brought to the attention of the provost. Students may also seek advice of the student ombudsperson in resolving a complaint.

Academic Standing and Satisfactory Academic Progress

To maintain satisfactory academic progress (SAP), students must achieve a required minimum grade point average (GPA) of 3.0, complete two-thirds (67%) of cumulative attempted courses, and are limited to a maximum of 45.0 attempted credits. Attempted and completed courses include courses for which A-F letter grades or (CR) Credit/(NC) No Credit were assigned. Attempted but not completed courses include courses with grades of (I)ncomplete or (W)ithdrawn. Courses that are not counted in the attempted calculation include courses taken for audit and courses with grades of (Z) Continuing or (N)o grade given.

The short duration of the program means that these requirements must be taken very seriously by all students immediately upon entry into the program. Students who do not make satisfactory academic progress or who receive an F in any course may be subject to academic disciplinary action. These actions may include academic probation, suspension, or dismissal. Academic probation means that the student is in danger of being suspended or dismissed from the program. It also means that the student should take immediate action to be more successful academically. A variety of actions may be required when a student is placed on academic probation, including, but not limited to, tutoring, exclusion from extracurricular activities, enrollment in specific courses, and/or limiting the number of classes taken in a semester. In addition, students must have a grade point average of B (3.0) or better to graduate.

Suspension, dismissal, and graduation are authorized by the associate dean of master’s program. Any suspension, dismissal, or graduation decision made by associate dean of master’s program may be appealed within seven days to the Senior Associate Dean for Education and Learning Innovation.

Admission Revocation

The MEM Program reserves the right to rescind any applicant’s admission to the program if new information arises pertaining to significant academic performance issues, criminal activity, Duke Community Standard violations, or other extraordinary circumstances. In general, significant issues that justify withdrawing an offer of admission would be those that could lead to a suspension or dismissal if a student were already enrolled in the MEM Program.

Decisions to revoke admissions will be made by the MEM Program Admissions Committee, and appeals will be heard by the Senior Associate Dean for Education and Learning Innovation.
Advising
Each MEM student is assigned an academic advisor who is available to assist with questions regarding topics such as career direction and academic preparation for the student's desired career.

These advisors are available as a resource. An advisor will not contact a student individually to set up a meeting, but a student is welcome to contact them with questions or to set up a meeting. Students seeking advice should contact their advisor to discuss questions or to arrange for a meeting time. Even if an advisor's background differs from the student's own, they can be a very helpful resource.

As a graduate student, academic advising is very different from advising as an undergraduate. Students should not rely on their advisor to make their own course decisions. Students should make sure to assess their individual career interests and the knowledge required to be successful in the field, and then identify potential course options consistent with their personal career goals before meeting with their advisor. The student's advisor can then provide advice about final course decisions.

Audits
Audits are permitted on a space-available basis with the consent of the instructor and the MEM Program director (see Audit Permission form on the MEM Student Resources website). Audit Permission Forms must be turned in by the last day of the Drop/Add period set forth by the registrar's office. Students may audit only one course per fall and spring semesters; no courses may be audited during the summer terms.

The fee for auditing a course depends on a student's tuition payment option. Degree students registered for regular MEM courses and who have selected the pay-by-semester payment option may audit a course without being charged. Degree students registered for regular MEM courses and who have selected the pay-by-unit payment option may audit a course but will incur an audit fee for each course audited. This policy is in effect for all students, even if a student decides to change from pay-by-semester to pay-by-unit in their last semester of the program.

It is important that students understand an instructor's expectations for auditing a course, such as completing assignments and readings, participating in class, etc. Auditing students must comply with these requests to successfully complete the audit, as it is possible to fail.

Degree candidates may unofficially sit in on courses with just the permission of the instructor; no forms are necessary in this case. Generally, nondegree seeking candidates may not audit or sit in on courses; however, alumni of the MEM Program, Post-docs, and students from MEM Program Consortium Schools who wish to audit a class for personal or professional development will be considered on a case-by-case basis.

Complaints
If a student has a concern with a course or with an aspect of the program, the concern should first be addressed to the faculty or staff member most associated with the area of concern. If the faculty or staff member is not able to address the concern, the matter may be brought to the attention of one of the MEM Program directors to address the situation. If a significant concern has not been addressed by one of the directors, the matter may be appealed in writing to the associate dean of master's programs.

Changing a Course
MEM courses generally follow the calendar for graduate students on the university registrar’s website (registrar.duke.edu/calendars-key-dates/academic-calendar). This calendar applies to engineering management courses and courses under The Graduate School’s oversight. Courses taken in The Fuqua School of Business follow the Fuqua School Daytime MBA calendar, which can be found on the Fuqua Daytime MBA website (fuqua.duke.edu/programs/daytime-mba/program-format). Fuqua operates on a term basis with two terms per semester; therefore, courses are compressed into an intense six-week schedule.

The Graduate School and The Fuqua School of Business set Drop/Add dates for their respective courses and those dates are followed accordingly. If a course is dropped after the Drop/Add period, the status of the student at the time of withdrawal from the course will be indicated on their permanent record as a withdraw (W). To withdraw from a course, fill out the Course Withdrawal Form on the MEM Student Resources website. A student seeking a course withdrawal will first meet with their academic dean to discuss eligibility and desirability of making a change in the student's semester schedule. In general, students found responsible for academic cheating in a course with a consequence of a reduced grade will not be eligible to withdraw from that class. If the student is authorized to withdraw by the dean, the student will seek a signature from the course instructor. This policy provides an opportunity for the student to discuss the issues leading to the student's request and to determine whether the student is fully informed about performance, grading, and
readiness for the course. The signature also provides the mechanism by which instructors learn that the student will no longer be a member of the class. The last day to withdraw from a course without a W generally is the last day of the Drop/Add period. The last day to withdraw from a course with a W is the last day of classes for each semester.

**Section Changes for Core Courses**

Because the MEM Program is a one-year program, it is imperative that students take the core courses offered each semester. Often, one or two sections of a particular core course fill up and students with conflicts between elective courses and core courses are unable to register. Students are initially encouraged to voluntarily redistribute from full sections to open sections. If a voluntary redistribution is not sufficient, students without conflicts may be randomly selected and switched to an alternate section of a core course in order to ensure that all students are able to complete their degree requirements.

**Courses at Nearby Universities**

Under the interinstitutional registration agreement, any MEM student enrolled as a degree-seeking student at any of the following universities may take technical electives at the following universities:

- North Carolina Central University
- North Carolina State University
- The University of North Carolina at Chapel Hill
- The University of North Carolina at Charlotte
- The University of North Carolina at Greensboro

Permission of the MEM Program director or executive director is required and students will be charged Duke University tuition rates for such courses. Distance courses may not be taken under an interinstitutional transfer agreement. More information about interinstitutional registration can be found on the university registrar's website at registrar.duke.edu/interinstitutional-duke-students-visiting-other-campuses.

MEM students are not permitted to take interinstitutional or non-EGRMGMT classes during the summer. Students are also not permitted to take interinstitutional classes in their final term as late grade submission may delay graduation.

**Dual-Degree and Joint Programs**

Information about dual-degree options and joint programs is available at mem.pratt.duke.edu/campus/flexible-degree-options.

**Duke University Policies**

Policies that apply to all students at Duke University may be found at policies.duke.edu/students. In some cases, the Master of Engineering Management Program may have supplemental policies to Duke University Policies. If the Master of Engineering Management Program policies or adjudication procedures contradict Duke University Policies, Duke University Policies and procedures take precedence.

**Early Career Program and 4+1 Program for Duke Students**

Recent graduates of a Duke University bachelor's degree program can apply for the MEM Early Career Program up to five years after graduation. Admission must be approved by the MEM Program and by the Pratt School of Engineering. Recent graduates who have unused graduate-level (at the 500 level or above) elective credits as part of their undergraduate degree can transfer up to 4 courses into the MEM program.

Students enrolled in the Early Career Program will follow the standard application deadlines. Applicants are not required to take the GRE and are not charged an application fee. Students may request to transfer their admission to the MEM Online program.

Advanced Duke undergraduates may participate in a 4+1 Program where both a bachelor's degree and a MEM degree may be completed in 4.5 to 5 years. In the 4+1 Program, students may typically apply up to four graduate courses (at the 500 level or above) that were taken during their undergraduate career but not used to fulfill undergraduate degree requirements toward MEM degree requirements.

To be considered for the 4+1 Program, undergraduates may apply for MEM Program admission during the standard admission cycle for entrance. Applicants are not required to take the GRE and are not charged an application fee. Students should consider the following guidelines when submitting materials:

- apply in the spring of junior year for admission in the fall semester of the student's senior year;
- apply in the fall of senior year for admission in the spring semester of the student’s senior year.
Admission decisions will be made and communicated to the student following the published admissions decision calendar. Matriculation will typically occur in Summer Session 1 after the spring semester of the senior year unless a student opts for the 4+1 deferred enrollment option. Therefore, students will pay undergraduate tuition for the first four years of study and will pay MEM Program tuition for the fifth year of study. The 4+1 deferred enrollment option allows a student to defer enrollment for up to 3 years.

MEM courses are not typically available to undergraduates. After admission, 4+1 students work with the student records coordinator to register for EGRMGMT courses while an undergraduate. Not all graduate-level courses are available to undergraduates, and registration will only be provided for EGRMGMT courses.

Generally, for graduate courses taken as an undergraduate to be transferred and counted toward the MEM degree, the courses must meet the following conditions:

- A maximum of four courses may be transferred to the MEM degree;
- Transferred courses may not have been used to fulfill any undergraduate degree requirements;
- Transferred courses must fulfill MEM degree requirements; and
- A grade of B or better must have been earned in the course.

To transfer course credit, an Early Career Program or 4+1 student should complete the Pratt Credit Transfer Form and obtain approval from the associate dean for undergraduate studies in the Pratt School of Engineering or the student’s academic dean in the Trinity College of Arts & Sciences and the executive director of the MEM Program. Please note that the undergraduate course credits transfer to the MEM degree, but the grade earned will remain part of the student’s undergraduate GPA and will not be used to calculate a MEM GPA.

**Exemption from a Core Course**

A student may request an exemption from a core course if they have already taken a substantially similar course. Receiving an exemption does not decrease the number of courses that must be taken. The previously-taken course will fulfill the degree requirements for the corresponding MEM core course, which allows the student to take one additional technical elective in its place.

In order for a course exemption to be considered, students must submit the syllabus for the previous course and the current MEM course, the student’s transcript that includes the grade received for the previous course (should be a B or better), and the student’s assessment of why the previous course and Duke’s course are substantially similar. The exemption request should be made to the executive director who will review the submitted materials and consult with the appropriate individual(s) before making a determination. All course exemptions are made on a case-by-case basis. A course with a title similar to a MEM core course is not sufficient justification for a course exemption. For the Course Waiver Application form and more information on the Course Waiver Policy, see MEM Student Resources website.

**Extra Courses/Semesters at Duke**

**Master of Engineering Management Program**

The Master of Engineering Management degree can be earned in one to two years. Students completing four classes per semester can complete the degree in as little as two semesters and an internship. Students completing three classes per semester can complete the degree in three semesters and an internship. Limitations on the number of additional courses/semesters are at the discretion of the Associate Dean and executive director of Professional Master’s Programs in consultation with their program committee. Full-time students who begin the program in the fall, should complete the MEM degree in no more than 22 months; full-time students who begin the program in the spring or summer, should complete the degree in no more than 24 months.

Students are responsible for maintaining good academic standing (generally considered to be a B average); thus, they should consider this when determining the number of courses to take each semester. While many students are able to manage large course loads and extracurricular activities, others may find it difficult to do so successfully. It is very much an individual consideration as to how many courses is too many. Note that the Drop/Add date is relatively early in the semester and should be kept in mind if a student decides to register for or drop out of an extra course.

**Master of Engineering Management Online Program**

The online Master of Engineering Management degree generally can be earned in two to four years. Students completing two classes per semester can complete the degree in as little as two years. Students completing one class per semester can complete the degree in four years. Limitations on the number of additional courses/semesters are at the discretion of the director of Online and Distance Education. Students must pay at least the full tuition amount for the program prior to graduating. Students are responsible for
maintaining good academic standing (generally considered to be a B average), thus, should consider this when determining the number of courses to take each semester. While many students are able to manage large course loads and still make time for work and extracurricular activities, others may find it difficult to do so successfully.

Full-Time versus Part-Time
To be considered a full-time student, students must be registered for at least three graduate-level courses (9.0 course credits). Enrolling in fewer than three courses (9.0 credits) is considered part-time. International students must be enrolled full-time to maintain a valid visa with the exception of their final semester if their degree will be completed at the end of that semester. All students in their final semester must register for at least 3.0 tuition-bearing units (this does not include EGRMGMT 550 or EGRMGMT 551).

Fuqua Electives
A few select Fuqua electives are open to full-time Duke graduate students with two caveats: (1) admission is strictly on a space-available basis; and (2) permission from the instructor is required. Please note that not all Fuqua electives are approved as MEM technical electives. A list of approved MEM technical electives offered by Fuqua may be accessed on the MEM Student Resources website. MEM students cannot directly enroll online and must comply by the Fuqua registration process and deadlines. Please review the registration information provided in the MEM Academic Information folder under the MEM Student Resources website. Online students cannot access Fuqua classes online. Fuqua MBA Core Courses are not open to non-Fuqua students.

Grading
Standard Courses: A=Exceptional; B=Good; C=Satisfactory; (A, B, and C grades may include + or -); F=Failure; I=Incomplete; N=No Grade Given; W=Withdraw; Z= Satisfactory Completion of the first term of a two-course sequence
Audit: AD=Audit; WA=Withdrawal Audit; N=No Grade Report
Credit/No Credit (including Internship Courses): CR= Passing; NC=Failure

Incomplete Grades
Incomplete grades are to be assigned if, because of illness or other extenuating circumstances, a student’s work in the course is incomplete. Students should make arrangements with their course instructor prior to the end of the semester if they anticipate that their work will be incomplete, and should work with their instructor to develop a plan for completing the work. Students who are given an incomplete must complete the work within one year or the I grade will become permanent.

Graduation
It is each student’s responsibility to ensure that they have successfully completed all degree requirements for graduation, including the timely submission of the graduation application on DukeHub during the Apply for Graduation window. A list of requirements is outlined below. Graduation will be delayed if a student does not complete all requirements within the required time frame.
MEM Program graduation requirements are as follows:

- Four core management courses:
  - Engineering Management 510 (Marketing)
  - Engineering Management 520 (Intellectual Property, Business Law, and Entrepreneurship)
  - Engineering Management 530 (Finance and Accounting for Technology-Based Companies)
  - Engineering Management 540 (Management in High-Tech Industries)
- Four graduate-level technical elective courses, typically 500 level and above, chosen from:
  - departments within the Pratt School of Engineering, including engineering management electives
  - courses outside of the Pratt School of Engineering with the director’s approval; and
  - courses at partnering universities through the Interinstitutional Registration Agreement, with the director’s approval.
- Internship, written project summary, and oral presentation (Engineering Management 550 and Engineering Management 551)
- Two semesters of the MEM Seminar and Workshop Series (Engineering Management 501)*
- Complete the graduation application on DukeHub during the Apply for Graduation window. Failure to apply may delay graduation and/or the receipt of the student's diploma. (If, for any reason, a student needs to change their graduation date, they must contact the student records coordinator for approval)

*MEM Online students complete three residencies to fulfill the Seminar and Workshop Series requirement.
Students may track their degree progress and ensure they are fulfilling all degree requirements by logging into Stellic, an online degree auditing platform, using their NetID and password. International students should ensure that their intended graduation date is consistent with their visa status (see the Duke Visa Services Office website, visaservices.duke.edu).

**Immunization Requirements**

North Carolina State Law (General Statutes §130A 152–157) requires that all students entering college present a certificate of immunization that documents that the student has received all immunizations required by law. While a student's state or country of origin may have different immunization requirements, all students must comply with North Carolina laws and Duke requirements. Entering students must present proof of immunizations to Student Health Services prior to the student's first day of class. Failure to comply with the State of NC and Duke University Immunization Requirements will result in the deactivation of a student's DukeCard. A student's registrar will be notified and they will not be able to attend class or register for future classes. More information about the immunization requirements can be found at studentaffairs.duke.edu/studenthealth/immunization-compliance.

**Independent Studies**

Independent study (Engineering Management 591) courses may be pursued by identifying a specific topic and an interested faculty member who is willing to instruct an independent study course. The topic and faculty approval should be sent to the academic coordinator so they can enroll the student in the appropriate independent study course. Students may take up to two independent study courses as technical electives for their degree.

**Leave of Absence**

The MEM and MEM Online programs are designed to accommodate both part-time and full-time students. It is generally expected that continuous enrollment will be the norm for all students regardless of their status as part-time or full-time. That is, for full-time MEM students, continuous enrollment of three or more courses per semester and for part-time students, continuous enrollment of one or more courses per semester is generally expected. For MEM Online students, continuous enrollment of at least one course per semester is generally expected. Students who do not enroll in courses during the fall or spring semester may be contacted by their department to explain their program enrollment intentions. If the student is unresponsive to the program after multiple attempts at contact, they may, at the discretion of the associate dean for master's programs, be placed on an administrative leave of absence.

It is understood that circumstances and personal situations may sometimes require that students interrupt their education for some period of time. The deadline for a leave of absence is the last day of classes in a semester and is not typically granted once classes have ended and final exams have begun. All leave of absence forms (personal, medical, and academic) can be found on the MEM Student Resources website under Academics, Policies and Forms.

A personal leave of absence is appropriate if a student has a personal situation to address away from school.

A medical leave of absence should be considered if, due to physical or mental health problems, continuing in courses is impossible for a student. A letter from the student's medical provider may be required to grant a medical leave of absence.

Except in unusual circumstances, a leave of absence of one or two years will be granted. A leave of absence greater than two years is generally not allowed. A student will need to begin the MEM Program again if a leave of absence greater than two years has occurred. The directors of the MEM Program may make exceptions to this general rule.

A leave of absence, students must reapply and admission is not guaranteed. Students must complete the application and include an explanation of the circumstances surrounding the withdrawal, along with a statement describing the withdrawal and their reflections during their time away from Duke.

Foreign national students who wish to work in the United States after graduating need to understand the laws and policies regarding a leave of absence and the requirements upon readmission. Returning from a leave of absence greater than five months will require the student to reapply for their F-1 visa prior to entering the United States and returning to the program at Duke University. Additionally, work authorization laws set forth by the United States Department of Homeland Security require foreign national students to have maintained active status in their program of study for at least one academic year, two consecutive semesters not including the summer term, to be eligible for either Curricular Practical Training or Optional Practical Training. Therefore, foreign national students returning from a leave of absence must complete two consecutive semesters of course work, regardless of how many credits they have completed toward the master of engineering management degree.

**Nondegree Option**

Students who do not intend to obtain a MEM degree but are interested in some of the MEM courses may take MEM courses (i.e., courses designated as EGRMGMT) as a nondegree student. Nondegree status is distinct from MEM degree student status. Thus, if a
student decides to become a part-time or full-time MEM degree student, a separate application and processing fee are required, and applicants must adhere to our standard admissions deadlines. A maximum of four EGRMGMT courses taken as a nondegree student may be applied to the MEM degree program if the student is admitted. Only classes where the student earned a B or better are eligible to be transferred to the degree program. Note that tuition for these courses is paid separately from any other programs in which a student is currently enrolled. A nondegree student may be withdrawn from the active status if they have not taken a course for a period of three consecutive academic years. If withdrawn, the student will need to reapply to the program in order to take classes.

Non-MEM Student Registration

Graduate and professional students who are not enrolled in the MEM Program may register for some MEM courses (i.e., courses designated as EGRMGMT) on a space-available basis and with permission of the instructor. Instructors will require students to have sufficient background for the course as needed and may also limit outside enrollment for any pedagogical reason. For example, some courses require very close teamwork and thus may be hindered by allowing students outside of the MEM Program to enroll in the course. Generally no more than five non-MEM students will be allowed to enroll in a course at any given time. Students who enroll in MEM courses as non-MEM students may not utilize these courses for an MEM degree. Generally the MEM core courses are not available to non-MEM students. The core courses for the MEM Program are as follows:

- Engineering Management 510 (Marketing)
- Engineering Management 520 (Intellectual Property, Business Law, and Entrepreneurship)
- Engineering Management 530 (Finance in High-Tech Industries)
- Engineering Management 540 (Management of High-Tech Industries)

For non-MEM students enrolling in MEM courses, no additional fees beyond their degree program fees will be charged by the MEM Program. To enroll into a MEM course, the student must fill out a Course Registration Permission Form found on the MEM Student Resources website under Academics, Policies and Forms

Regrading an Assignment, Exam, or a Course

Grading is up to the individual faculty member in each course; however, there are some general comments that apply to most courses. Most of the questions received after grading an exam or the entire course are very reasonable and well thought out. However, some indicate that it is necessary to reiterate the philosophy on grades:

- The only reason for a grade to change is if the faculty member made a mistake. This means that students must persuade the faculty member that a mistake has been made.
- This type of persuasion does not generally start with “I want...,” “I need...,” or even “the company I work for requires...”
- As students in a management program, the student must take into account the manager’s (i.e., faculty member’s) perspective of fairness for the entire class. Please do not ask a faculty member to do something that is not fair for the entire class if the student were in the faculty position.

If a student believes a mistake was made on their exams or final course grade, they are encouraged to speak to the professor. The addition of points, transcription of points from the assignments to the grade book, etc. are all possible sources of error. Answering questions from a particular reading or resource that the instructor did not have in mind when the question was written may also be a source of grading error. A clear and logical argument for such mistakes should be easy to make. If a student is simply struggling to improve their grade, then it is likely they should not be requesting the regrading. If a student has evidence that a mistake was made in their grading and the instructor of the course does not consider this evidence the student should discuss the situation with one of the MEM Program directors.

Additionally, if a student is interviewing with companies that have a threshold of some minimum GPA and they are struggling to meet that minimum threshold, then perhaps the student is interviewing with the wrong companies. Generally, these same companies will ignore GPA in three years if the student can convey a record of accomplishments. If a student is on the borderline of GPA acceptability, then the directors urge students to consider changing their strategy of either which companies they would like to work for or how and when they plan to work for them.

In those exceptional cases where a problem remains unresolved through discussions with the professor or one of the MEM Program directors, an appeal may be made to the senior associate dean for the Pratt School of Engineering. Any appeal must be made in writing and must include a description of the error that was made in assigning a grade.

Retention of Examinations
Instructors are requested to retain all final examination papers for at least one year after the date the examination is given. Examination papers should be available for reference where a final grade is questioned.

Seminars and Workshops

Students will attend professional development seminars and workshops through EGRMGMT 501. Course policies are outlined in the course syllabus, which is provided to students on the course’s Sakai platform. Failing to follow course guidelines may result in unfulfilled requirements for the MEM Program and thus can prevent a student from receiving their degree. All students must complete two semesters of the seminar workshop course before graduating with their MEM degree.

Part-time students must enroll in two semesters of the seminar course and attend the equivalent of two semesters of seminars and workshops during their enrollment in the program. Part-time students must consult with the EGRMGMT 501 instructor before the semester’s Drop/Add period ends to discuss their involvement in the course.

This policy applies to MEM Program-sponsored weekly seminars and required workshops listed on the seminar course’s Sakai site. From time to time, the program may notify students of other seminars offered by other departments or optional seminars and workshops sponsored by the MEM Program. Attendance is encouraged at these seminars but is not required.

Summer School

The MEM Program only offers EGRMGMT 550 and 551 during the summer because that is when campus students complete their internship requirement. Typically, students take EGRMGMT 550 in the summer and EGRMGMT 551 in the fall immediately following the internship. Students planning to graduate in September should enroll in both EGRMGMT 550 and 551 in the summer. MEM students cannot take summer classes outside of the MEM Program to count towards their degree but may take courses for their own personal development. Foreign national students who are working on their internship in the United States during the summer will need to apply for Curricular Practical Training (CPT) and must enroll in EGRMGMT 550 over the summer. For more information about CPT, visit the Duke Visa Services website, visaservices.duke.edu.

Transferring Policies

Transferring Credits from Other Pratt School Departments into the MEM Program

Students may utilize up to three graduate courses taken as an MS or PhD student in the Pratt School of Engineering as technical electives in the MEM Program. Generally these courses should be taken concurrently with the MEM degree or within the previous four years. Thus, an MS or PhD student can receive the MEM degree by completing five additional courses, four of which are the core courses, the internship requirement, and the seminar series. Approval from the MEM Program executive director is required. Admission to the MEM Program is separate from admission to other graduate programs at the Pratt School of Engineering and the MEM courses are paid for separately from the student’s MS or PhD graduate courses.

Generally, the credits to be used for both degrees will only be seen on the MS/PhD transcript and will count only toward the student’s MS/PhD grade point average.

Students in dual degree programs will receive both degrees simultaneously. Students will not be permitted to receive one degree in a different term than the other, even if coursework for one of the degrees has been completed.

Transferring Credits from The Fuqua School of Business into an Ad Hoc Joint Degree with the MEM Program

If a student has completed the Fuqua MBA course requirements then they will be allowed to waive three of the core courses in the MEM Program: Engineering Management 510 (Marketing), Engineering Management 530 (Finance in High-Tech Industries), and Engineering Management 540 (Management in High-Tech Industries). Thus, a student can receive the MEM degree by completing five additional courses, the internship requirement, the seminar series and other miscellaneous required activities in the MEM Program. The five courses the student must complete include the required Engineering Management 520 (Intellectual Property, Business Law, and Entrepreneurship) core course and four technical electives. Admission to the MEM Program is separate from admission to The Fuqua School of Business.

Transferring Credits from Other Universities

Transfer of credits for courses from other universities is not allowed. A total of 30.0 credits must be taken at Duke. If a student has taken graduate courses at another university that were not used for their degree, they may give the student a bit more leeway in the types of courses that can be taken at Duke but they do not decrease the total number.
Transferring Credits from the Naval Nuclear Power Training Command

Students in the United States Navy, who have completed their Nuclear Power Training, may transfer a maximum of six credit hours toward the Master of Engineering Management degree. These credits will be listed as Duke Equivalent courses with the grade 'TR.' In order to transfer Nuclear Power Training course credit, students must submit their academic and Joint Services Transcripts to the academic coordinator after admission to the MEM Program. The academic coordinator will request that the registrar transfer 6.0 credits to the student's academic record.

Transferring from Other Pratt School Departments into the MEM Program

Students leaving a MEng, MS, or PhD program in the Pratt School of Engineering may utilize up to four graduate courses in that program taken toward their MEM degree. For MEng students, all grades will count toward the MEM GPA. For MS and PhD students, only the courses that are transferred will count toward the MEM GPA.

Generally, for graduate courses to be transferred and counted toward the MEM degree, the courses must meet the following conditions:

- transferred courses must fulfill MEM degree requirements; and
- a grade of B or better must have been earned in the course.

To transfer course credit, matriculated students should complete the Pratt Credit Transfer Form.

Transferring from Non-Pratt Duke Departments into the MEM Program

Students leaving a graduate degree program outside of the Pratt School of Engineering may utilize up to two graduate courses in that program taken toward their MEM degree. The courses that are transferred will count toward the MEM GPA.

Generally, for graduate courses to be transferred and counted toward the MEM degree, the courses must meet the following conditions:

- transferred courses must fulfill MEM degree requirements; and
- a grade of B or better must have been earned in the course.

To transfer course credit, matriculated students should complete the Pratt Credit Transfer Form.

Transferring between MEM Program and MEM Online

Students must be approved to transfer between the campus MEM Program and the MEM Online Program. The MEM Online degree is designed as a separate program distinctly targeted to working professionals with industry experience. Only on an exceptional basis for compelling reasons will a student be allowed this option. The student must meet with and be approved by the MEM Executive Director. Similarly, MEM Online students wanting transfer to the campus MEM Program must meet with and be approved by the director of Online and Distance Education.

Undergraduate-Level Courses

Courses below the graduate level, typically below the 500 level, may not be applied toward the required credits needed for the MEM degree. With the approval of the instructor of the undergraduate course, a program director, and the associate dean for Professional Master's Programs, students may enroll in lower-level courses, but these courses will not count toward graduation credit requirements and will not be included in a student's GPA calculation.

Withdrawal, Involuntary Administrative

Students who exhibit harmful, potentially harmful, or disruptive behavior toward themselves or others may be subject to involuntary administrative withdrawal from the university if their behavior renders them unable to effectively function in the university community. Such behavior includes, but is not limited to, that which

- poses a significant threat of danger and/or harm to self and/or other members of the university community; and/or
- interferes with the lawful activities or basic rights of other students, university employees, or visitors.

Any member of the university community who has reason to believe that a student may meet the standard for an involuntary administrative withdrawal may contact the vice president for student affairs or their designee. The vice president or designee will conduct a preliminary review in consultation with professionals from Student Health and/or Counseling and Psychological Services, the associate dean of master's program, and/or other relevant individuals. The vice president or designee will meet, when possible, with the student in question to discuss the information that has been presented and give the student an opportunity to respond. The vice
president or designee may mandate that the student be evaluated by a specified health professional within a given time frame if an
evaluation has not already been conducted. In the instances described above the vice president for student affairs or designee will
make the final decision about involuntary administrative withdrawal. A written statement citing the reasons will be forwarded to
associate dean of master’s program, who will withdraw the student from the university. At any point in the process the student may
request a voluntary withdrawal via the associate dean of master’s program.

MEM Online Residency Information

MEM Online offers a unique blend of learning delivery. The program combines the flexibility of remote coursework with close
interactions and support of a cohort and faculty. A key component of the success to building a community for each class is the
residency program. Each MEM Online student is required to attend three on-campus residencies throughout the duration of the degree.
Residencies allow MEM Online cohorts to meet, interact, and bond, as well as learn valuable tools for successfully navigating the MEM
Online delivery format. Being on campus enhances communication with professors and faculty, allowing the one-on-one personal
interaction necessary to forge strong ties and relationships with mentors. Through residency roundtables and workshops, students
build career development skills. Finally, social activities planned for these three weeklong stays provide a way to enjoy the camaraderie
of classmates.

The MEM Online residencies fulfill the Seminar and Workshop Series requirements that residential MEM Program students are required
to complete. Generally, students are expected to complete the residencies sequentially; however, the MEM Executive Director may
make exceptions for students with extenuating circumstances. These cases are rare and are considered on a case-by-case basis. For
students that transition between the residential MEM Program and MEM Online, the MEM Executive Director may approve a blended
combination of residencies and EGRMGMT 501 to fulfill this degree requirement.

Registration for residencies is performed along with course registration through DukeHub. Failure to register for and/or attend a
residency may delay graduation.

Residency 1: Orientation Residency (One week prior to the start of classes in Fall Year 1)

This residency initiates the MEM Online Program. Program introductions and updates are delivered, expectations are outlined, and
students have the opportunity to experience the Duke community. Highlights include distance technology/tooling overviews,
workshops, faculty interaction, and social activities for MEM Online cohorts.

Residency 2: Mid-Program Residency (One week in July between Years 1 and 2)

This residency provides students an opportunity to reconnect personally with faculty and cohorts. Seminars and workshops focusing on
professional development and business simulation activities will be required to supplement the remote classroom experience. Social
activities will further enhance relationship building amongst distance cohorts.

Residency 3: Capstone Residency (One week prior to May graduation in Spring Year 2)

The culmination of the MEM Online Program, this residency provides students the forum for final class presentations and assessments.
Interactions, discussions, and feedback mark the integration of learning and application. Social activities during this residency will bring
cohorts together for a final shared experience. Students participate in Duke’s graduation ceremonies alongside campus students.
Master of Engineering Academic Policies

The Master of Engineering (MEng) Program began in 2010 and provides students with the skills to effectively contribute to the technical needs of the twenty-first century global organization immediately upon graduation. The MEng degree is an applied, nonthesis degree that has a single departmental or program affiliation, or a defined interdisciplinary affiliation across more than one department.

As an applied, nonthesis degree, the MEng degree provides differentiated value by coupling graduate-level technical knowledge in key areas of strength with core business fundamentals, thus better preparing students to work in industry. The MEng degree is housed in, and managed by, the Pratt School of Engineering with faculty oversight provided by engineering school faculty through the Engineering Faculty Council and the existing departments and programs. The MEng degree positioned the Pratt School of Engineering to take a leadership role in developing a professional master’s curriculum that delivers state-of-the-art technical depth coupled with necessary business knowledge breadth to produce graduates who can truly impact their organizations. The disciplines within the Master of Engineering degree are:

- Artificial Intelligence for Product Innovation
- Biomedical Engineering
- Civil Engineering
- Computational Mechanics and Scientific Computing
- Cybersecurity
- Electrical and Computer Engineering
- Environmental Engineering
- Financial Technology
- Materials Science and Engineering
- Mechanical Engineering
- Medical Technology Design
- Photonics and Optical Sciences
- Risk Engineering

Academic Freedom

Freedom of inquiry and the free exchange of ideas are essential for the fulfillment of the university’s mission. Academic freedom is a right and responsibility of students as well as faculty. Students who believe that their academic freedom has been abridged should submit a written complaint to the associate dean of master’s program. The associate dean of master’s program may enlist the associate dean for faculty affairs and community engagement to provide advice. Cases not resolved by the associate dean of master’s program may be brought to the attention of the provost. Students may also seek advice of the student ombudsperson in resolving a complaint.

Academic Standing and Satisfactory Academic Progress

To maintain satisfactory academic progress (SAP), students must achieve a required minimum grade point average (GPA) of 3.0, complete two-thirds (67%) of cumulative attempted courses, and are limited to a maximum of 45.0 attempted credits. Attempted and completed courses include courses for which A-F letter grades or (CR) Credit/(NC) No Credit were assigned. Attempted but not completed courses include courses with grades of (I)Incomplete or (W)ithdrawn. Courses that are not counted in the attempted calculation include courses taken for audit and courses with grades of (Z) Continuing or (N)o grade given.

The short duration of the program means that these requirements must be taken very seriously by all students immediately upon entry into the program. Students who do not make satisfactory academic progress or who receive an F in any course may be subject to academic disciplinary action. These actions may include academic probation, suspension, or dismissal. Academic probation means that the student is in danger of being suspended or dismissed from the program. It also means that the student should take immediate action to be more successful academically. A variety of actions may be required when a student is placed on academic probation, including, but not limited to, tutoring, exclusion from extracurricular activities, enrollment in specific courses, and/or limiting the number of classes taken in a semester. In addition, students must have a grade point average of B (3.0) or better to graduate.

Suspension, dismissal, and graduation are authorized by the associate dean of master’s program. Any suspension, dismissal, or graduation decision made by the associate dean of master’s program may be appealed within seven days to the Senior Associate Dean for Education and Learning Innovation.

Admission Revocation
The MEng Program reserves the right to rescind any applicant’s admission to the program if new information arises pertaining to significant academic performance issues, criminal activity, Duke Community Standard violations, or other extraordinary circumstances. In general, significant issues that justify withdrawing an offer of admission would be those that could lead to a suspension or dismissal if a student were already enrolled in the MEng Program.

Decisions to revoke admissions will be made by the MEng Admissions Committee for the major of interest, and appeals will be heard by the associate dean for research and infrastructure.

**Advising**

Academic plans for the MEng students must be approved by an academic advisor. The implementation of this requirement will be determined by each major but could include an overall plan of study approval, a semester by semester approval of course choices and/or advising sessions for incoming students. A menu of course options can be an aid in this advising process. The student is responsible for determining that their plan of work will satisfy all graduation requirements for their major.

**Audits**

Audits are permitted on a space-available basis with the consent of the instructor and the director of master of engineering studies (DMS) for the student’s major (see Audit Permission Form). Students may only audit one course per fall and spring semesters. The fee for auditing a course depends on a student’s tuition payment option. Degree students registered for regular MEng courses and who are charged tuition on a per-semester basis may audit an additional course without being charged. Degree students registered for regular MEng courses and who have selected the pay-by-credit payment option may audit a course but will incur an audit fee of $535 for each course audited. This policy is in effect for all students, even if a student decides to change from pay-by-semester to pay-by-credit in their last semester of the program.

It is important that students understand an instructor’s expectations for auditing students, such as assignments, readings, class participation, etc. Auditing students must comply with these requests to successfully complete the audit, as it is possible to fail. Note that degree students may unofficially sit in on courses with just the permission of the instructor; no forms are necessary in this case. Generally, nondegree seeking students may not audit or sit in on courses; however, alumni of the MEng Program, and Post-docs who wish to audit classes for personal or professional development will be considered on a case-by-case basis.

**Complaints**

If a student has a concern with a course or with an aspect of the program, the concern should first be addressed to the faculty or staff member most associated with the area of concern. If the faculty or staff member is not able to address the concern, the matter may be brought to the attention of the appropriate DMS to address the situation. If a significant concern has not been addressed by the DMS, the matter may be escalated to the associate dean of master’s program. Complaint responses from the associate dean of master’s program may be appealed in writing to the associate dean of master’s programs.

**Concurrent MEng and PhD Degrees**

Students getting their PhD degree from the Pratt School of Engineering may also want to pursue a MEng degree to obtain the breadth found in the MEng core courses. To facilitate this, PhD students may utilize their PhD courses to fulfill the technical course requirements of the MEng degree (i.e., the eight noncore course requirements) if those courses meet the curricular requirements of the MEng major of interest. Thus, PhD students may obtain the MEng degree by adding the two MEng core courses to their coursework and fulfilling the internship requirements. Note that generally the student’s PhD research will not be acceptable as the internship experience for the concurrent MEng degree. Students must apply for the MEng Program independently from the PhD and must be enrolled in the MEng Program (i.e., dual enrolled in the MEng and PhD) before taking the MEng core courses. Students should register for these MEng core courses separately from their PhD courses under their MEng shopping cart and will be billed for these courses separately from their PhD. Other MEng courses to be utilized to fulfill the MEng requirements may be taken at any time while a PhD student, before or after enrolling in the MEng Program. Note that being accepted as a PhD student does not guarantee acceptance as a MEng student. Note that students will generally receive their MEng degree at the same time or after receiving their PhD. If a student does not obtain a PhD, only four of the technical courses taken as a PhD student may be applied to the MEng degree. The other four technical MEng course requirements and the MEng core courses must be taken after enrollment in the MEng Program. All PhD students should discuss their plans with their faculty advisor for their research program and with the DMS for their major of interest. When applying for the MEng degree, the student should indicate they are already a PhD student and plan to do the MEng concurrently with their PhD.

**Changing a Course**
MEng courses generally follow the calendar for graduate students on the university registrar’s website (registrar.duke.edu/calendars-key-dates/academic-calendar), including Drop/Add dates. This applies to master of engineering courses and courses under The Graduate School oversight.

A student seeking a course withdrawal after the end of the Drop/Add period will first meet with their DMS to discuss eligibility and desirability of making a change in the student's semester schedule. In general, students found responsible for academic cheating in a course with a consequence of a reduced grade will not be eligible to withdraw from that class. If the student is authorized to withdraw by the DMS, the student will seek a signature from the course instructor. The requirement for the instructor's signature provides an opportunity for the student to discuss the issues leading to the student's request and to determine whether the student is fully informed about performance, grading, and readiness for the course. The signature also provides the mechanism by which instructors learn that the student will no longer be a member of the class. Withdrawal from a class after the end of the Drop/Add period will result in a W on the student's transcript.

Section Changes for Core Courses
Because the MEng Program has a short duration, some students may require a specific core Industry Prep course in a specific semester in order to graduate. Often, one or two sections of a particular core course fill up and students with elective course conflicts with the core course are unable to register. The MEng Program will initially request that students voluntarily redistribute from full sections to open sections. If a voluntary redistribution is not sufficient, students without conflicts may be randomly selected and switched to an alternate section of a core course in order to ensure that all students are able to complete their degree requirements.

Courses at Nearby Universities
Under the interinstitutional registration agreement, any MEng student enrolled as a degree-seeking student at any of the following universities may take technical electives at the following universities:

- North Carolina Central University
- North Carolina State University
- The University of North Carolina at Chapel Hill
- The University of North Carolina at Charlotte
- The University of North Carolina at Greensboro

Permission of the DMS is required and students will be charged Duke University tuition rates for such courses. Distance courses may not be taken under an interinstitutional transfer agreement. More information about interinstitutional registration can be found on the university registrar’s website at registrar.duke.edu/interinstitutional-duke-students-visiting-other-campus.

MEng students are not permitted to take interinstitutional or non-Pratt classes during the summer. Students are also not permitted to take interinstitutional classes in their final term as late grade submission may delay graduation.

Dual-Degree and Joint Programs
Information about dual-degree options and joint programs is available at meng.pratt.duke.edu/about/options-current-duke-students-and-graduates.

Duke University Policies
Policies that apply to all students at Duke University may be found at policies.duke.edu/students. In some cases, the MEng Program may have supplemental policies to Duke University Policies. If MEng policies or adjudication procedures contradict Duke University policies, Duke University policies and procedures take precedence.

Early Career Program and 4+1 Program for Duke Students
Recent graduates of a Duke University bachelor’s degree program can apply for the MEng Early Career Program up to five years after graduation. Admission must be approved by the department/program in which the master's degree is sought and by the Pratt School of Engineering. Recent graduates who have unused graduate-level (at the 500 level or above) elective credits as part of their undergraduate degree can transfer up to 4 courses into the MEng program. Students enrolled in the Early Career Program will follow the standard application deadlines. Applicants are not required to take the GRE and are not charged an application fee.

Advanced Duke undergraduates may participate in a 4+1 Program where both a bachelor's degree and a MEng degree may be completed in five years. In the 4+1 Program, students may typically apply up to four graduate courses (at the 500 level or above) that were taken during their undergraduate career but not used to fulfill undergraduate degree requirements toward MEng degree requirements. Students on a case-by-case basis (such as AB Duke Scholarships that are available only to undergraduates) may be
allowed to apply up to six courses.

To be considered for the 4+1 program, undergraduates may apply for a MEng admission decision during the standard admission cycle for entrance. Applicants are not required to take the GRE and are not charged an application fee. Students should consider the following guidelines when submitting materials:

- apply in the spring of the student’s junior year for admission in the fall semester of the student’s senior year; or
- apply in the fall of the student’s senior year for admission in the spring semester of the student’s senior year.

Admission decisions will be made and communicated to the student following the published admissions decision calendar. Although an admission decision may be made before or during the student’s senior year, matriculation into the MEng Program will generally not occur until the undergraduate degree has been earned. Matriculation will occur in Summer Session 1 after the spring semester of the senior year unless a student opts for the 4+1 deferred enrollment option. Therefore, students will pay undergraduate tuition for the first four years of study and will pay MEng tuition for the fifth year of study. The 4+1 deferred enrollment option allows a student to defer enrollment for up to 3 years.

MEng courses are not typically available to undergraduates. After admission, 4+1 students work with the student records coordinator to register for MENG courses while an undergraduate. Not all graduate-level courses are available to undergraduates, and registration will only be provided for MENG courses. If a 4+1 student desires to take graduate-level elective classes that are not available to undergraduates, a 4+1 student should take these courses in the fifth year of study.

Generally, for graduate courses taken as an undergraduate to be transferred and counted toward the MEng degree:

- a maximum of four graduate-level courses may be transferred to the MEng degree
- transferred courses may not have been used to fulfill any undergraduate degree requirements
- transferred courses must fulfill MEng degree requirements in the major of interest
- a grade of B or better must have been earned in the course.

To transfer course credit, an Early Career Program or 4+1 student should complete the Pratt Credit Transfer Form and obtain approval from the associate dean for undergraduate studies in the Pratt School of Engineering or the student’s academic dean in the Trinity College of Arts & Sciences and the DMS for the student’s MEng degree. Please note that the undergraduate course credits transfer to the MEng degree, but the grade earned will remain part of the student’s undergraduate GPA and will not be used to calculate a MEng GPA.

For 4+1 students in the Trinity College of Arts & Sciences, preparation for success in a graduate engineering program may require that additional undergraduate courses must be taken as prerequisites. These prerequisite courses would be in addition to the 30 course credits required for the MEng degree. It is suggested that 4+1 students discuss their program of study with the DMS to understand the expectations in earning the degree. Depending on the extent of the prerequisite courses required, it may not be possible to complete the MEng degree in only one additional year.

**Extra Courses/Semesters at Duke**

The MEng degree can be earned in one to two years. Full-time students will typically take 9.0 to 12.0 course credits per semester. Students who desire to take 15.0 or more course credits in a semester should seek the approval of the DMS. For full-time students, the degree should be completed in no more than two years. Students are charged on a per-semester basis; however, students in their fourth semester may elect to be charged on a per-unit basis if they wish to take fewer than 10.0 credits.

**Full-time versus Part-time**

To be considered a full-time student, students must be registered for at least 9.0 course credits. Enrolling in fewer than 9.0 course credits is considered part-time. International students must be enrolled full-time to maintain a valid visa with the exception of their final semester if their degree will be completed at the end of that semester. All students in their final semester must register for at least 1.0 tuition-bearing credit.

**Grading Policies**

**Standard Courses:** A=Exceptional; B=Good; C=Satisfactory; (A, B, and C grades may include + or -); F=Failure; I=Incomplete; N=No Grade Given; W=Withdraw; 2= Satisfactory Completion of the first term of a two-course sequence

**Audit:** AD=Audit; WA=Withdrawal Audit; N=No Grade Report

**Credit/No Credit (including Internship Courses):** CR= Passing; NC=Failure
Incomplete Grades
Incomplete grades are to be assigned if, because of illness or other extenuating circumstances, a student's work in the course is incomplete. Students should make arrangements with their course instructor prior to the end of the semester if they anticipate that their work will be incomplete, and should work with their instructor to develop a plan for completing the work. Students who are given an incomplete must complete the work within one year or the I grade will become permanent.

Graduation
It is each student's responsibility to ensure that they have completed requirements for graduation, including the timely submission of the graduation application on DukeHub. A list of requirements is outlined below. Graduation will be delayed if a student does not complete all requirements within the required time frame.

MEng students in all disciplines must complete at least 30.0 course credits composed of key program elements, as follows:

- Core industry preparatory courses (6.0 course credits)
  - Master of Engineering 570 (Business Fundamentals for Engineers)
  - Master of Engineering 540 (Management of High Tech Industries)
- Departmental or interdisciplinary core courses (15.0 to 18.0 graduate course credits, varies by program)
- Technical electives in a concentrated area (6.0 to 9.0 graduate course credits, varies by program)
- Internship, Project, or Equivalent and Project Assessment
  - Master of Engineering 550 (Master of Engineering Internship/Project)
  - Master of Engineering 551 (Master of Engineering Internship/Project Assessment)

International students should ensure that their intended graduation date is consistent with their visa status (see the Duke Visa Services Office website, visaservices.duke.edu).

Immunization Requirements
North Carolina State Law (General Statutes §130A 152–157) requires that all students entering college present a certificate of immunization that documents that the student has received all immunizations required by law. While your state or country of origin may have different immunization requirements, you must comply with North Carolina laws and Duke requirements. Entering students must present proof of immunizations to Student Health Services prior to the student's first day of class. Failure to comply with the State of NC and Duke University Immunization Requirements will result in the deactivation of your DukeCard. Your registrar will be notified and you will not be able to attend class or register for future classes. More information about the immunization requirements can be found at studentaffairs.duke.edu/studenthealth/immunization-compliance.

Independent Studies
Independent studies can be an effective tool for custom plans of study. However, they should not be overused or used to avoid more structured plans of study. Students may take up to two independent study courses as technical electives for their degree. An instructor and a DMS from the student's major must approve all independent studies.

Internships
Internships are meant to provide an applied experience for the MEng student. Responsibility for finding an internship lies with each student. The Career Center offers resources to facilitate successful searches including resume reviews and interview practice. Different disciplines may have somewhat different requirements or suggestions regarding the internship; thus, students should check with their individual discipline to ensure they are fulfilling specific discipline requirements.

Learning Objectives
- Apply engineering principles to solving one or more problems outside of the classroom environment.
- Define a problem and determine potential solutions.
- Appreciate the importance of organizational dynamics and work relationships.
- Practice professional communication in two forms: written and oral.
- Complement the material presented in the courses of the MEng degree program.
- Practice self-assessment.

Implementation Guidelines
General Guidelines

- The internship is a zero-credit course, but a course number (Master of Engineering 550) is provided to enable a simple way to track fulfillment of the requirement.
- The minimum hourly requirement for the internship is 320 hours (eight weeks, forty hours per week).

Internship Types

- The internship can be a paid or unpaid experience, including a company or government summer job.
- Internships in research labs are acceptable if the major allows such experiences and they meet the learning objectives.
- International internships are encouraged as long as they meet the learning objectives.
- Part-time internships are acceptable as long as they meet the minimum hourly requirement and the learning objectives.
- Internships before the student receives a bachelor’s degree will generally not be allowable as a MEng internship unless the student is enrolled in a concurrent bachelor’s/MEng Program.
- Guidelines on what constitutes an acceptable internship will be provided to all students, including the learning objectives and templates of the completion requirements.
- Some programs will accept a project or an applied research experience in lieu of an internship experience. Students who wish to complete a project or applied research experience should contact the DMS for additional information.

Completion Requirements

- Successful completion of the internship will be verified by the DMS/program for each discipline and will include a written and/or oral project report (implementation will be determined by each discipline, examples include: poster session, oral presentation, project report, sponsor verification, etc.).
- Upon completion of the internship all MEng students will fill out a common form for their file, which includes information such as the participating organization, the activities undertaken, the dates of the internship, the title of the position, the contact information of the student’s supervisor.
- Students must also enroll in MENG 551 in which they will write a report about their internship experience and complete a final presentation summarizing the experience.

Leave of Absence

The MEng Program is designed to accommodate both part-time and full-time students. It is generally expected that continuous enrollment will be the norm for MEng students regardless of their status as part-time or full-time. That is, for full-time students, continuous enrollment of three or more courses per semester and for part-time students, continuous enrollment of one or more courses per semester is generally expected. Students who do not enroll in courses during the fall or spring semester may be contacted by their program to explain their program enrollment intentions. If the student is unresponsive to the program after multiple attempts at contact, they may, at the discretion of the associate dean for master’s programs, be placed on an administrative leave of absence.

It is understood that circumstances and personal situations may sometimes require that students interrupt their education for some period of time. The deadline for a leave of absence is the last day of classes in a semester and is not typically granted once classes have ended and final exams have begun. All leave of absence forms (personal, medical, and academic) can be found on the Graduate Student Programs and Services website under Academic Resources.

A personal leave of absence is appropriate if a student has a personal situation to address away from school.

A medical leave of absence should be considered if, due to physical or mental health problems, continuing in courses is impossible for a student. A letter from the student’s medical provider may be required to grant a medical leave of absence.

Except in unusual circumstances, a leave of absence of one or two years will be granted. A leave of absence greater than two years is generally not allowed. A student will need to begin the MEng Program again if a leave of absence greater than two years has occurred. The directors of the MEng Program may make exceptions to this general rule.

After a leave of absence, students must reapply and admission is not guaranteed. Students must complete the application and include an explanation of the circumstances surrounding the withdrawal, along with a statement describing the withdrawal and their reflections during their time away from Duke.

Foreign national students who wish to work in the United States after graduating need to understand the laws and policies regarding a leave of absence and the requirements upon readmission. Returning from a leave of absence greater than five months will require the student to reapply for their F-1 visa prior to entering the United States and returning to the program at Duke University. Additionally, work authorization laws set forth by the United States Department of Homeland Security require foreign national students to have been pursuing their degrees as full-time students for at least one academic year, two consecutive semesters not including the summer term,
to be eligible for either Curricular Practical Training or Optional Practical Training. Therefore, foreign national students returning from a leave of absence must complete two consecutive semesters of full-time course work, regardless of how many credits they have completed toward the master of engineering degree.

Nondegree Option
Students who do not intend to obtain a MEng degree but are interested in some of the MEng courses may take them (i.e., courses designated as MENG) as a nondegree student. Nondegree status is distinct from MEng student status. Thus, if a student decides to become a part-time or full-time MEng degree student, a separate application and processing fee are required, and applicants must adhere to our standard admissions deadlines. A maximum of two MENG courses taken as a nondegree student may be applied to the Master of Engineering Program if the student is admitted. Only classes where the student earned a B or better are eligible to be transferred to the degree program. Note that tuition for these courses is paid separately from any other programs in which a student is currently enrolled. A nondegree student may be withdrawn from the active status if they have not taken a course for a period of three consecutive academic years. If withdrawn, the student will need to reapply to the program in order to take classes.

Non-MEng Student Registration
Graduate and professional students who are not enrolled in the Master of Engineering Program may register for some master of engineering courses (i.e., courses designated with MENG course numbers) on a space-available basis and with permission of the instructor. Instructors will require students to have sufficient background for the course as needed and may also limit outside enrollment for any pedagogical reason. Students who enroll in MENG courses as non-MEng students may not utilize these courses for a MEng degree if they have been used to satisfy coursework requirements for another degree at Duke.

For non-MEng students enrolling in MEng courses, no additional fees beyond their degree program fees will be charged by the MEng Program.

Regrading an Assignment, Exam, or a Course
Grading is up to the individual faculty member in each course; however, there are some general comments that apply to most courses.

Most of the questions received after grading an exam or the entire course are very reasonable and well thought out. However, some indicate that it is necessary to reiterate the philosophy on grades:

- The only reason for a grade to change is if the faculty member made a mistake. This means that students must persuade the faculty member that a mistake has been made.
- This type of persuasion does not generally start with “I want...,” “I need...,” or even “the company I work for requires...”
- As students in an academic program that includes management and business training, students must take into account the manager’s (i.e., faculty member’s) perspective of fairness for the entire class. Please do not ask a faculty member to do something that is not fair for the entire class if they were in the faculty position.

If a student believes a mistake was made on their exams or final course grade, they are encouraged to speak to the professor. The addition of points, transcription of points from the assignments to the grade book, etc. are all possible sources of error. Answering questions from a particular reading or resource that the instructor did not have in mind when the question was written may also be a source of grading error. A clear and logical argument for such mistakes should be easy to make. If a student is struggling simply to improve their grade then it is likely they should not be requesting the regrading. If a student has evidence that a mistake was made in their grading and the instructor of the course does not consider this evidence the student should discuss the situation with the DMS. Additionally, if a student is interviewing with companies that have a threshold of some minimum GPA and they are struggling to meet that minimum threshold, then perhaps the student is interviewing with the wrong companies. Generally, these same companies will ignore GPA in three years if the student can convey a record of accomplishments. If a student is on the borderline of GPA acceptability, then they are urged to consider changing their strategy of either which companies they would like to work for or how and when they plan to work for them. In those exceptional cases where a problem remains unresolved through discussions with the professor and the DMS, an appeal may be made to the Senior Associate Dean for Education and Learning Innovation. Any appeal must be made in writing and must include a description of the error that was made in assigning a grade.

Retention of Examinations
Instructors are requested to retain all final examination papers for at least one year after the date the examination is given. Examination papers should be available for reference where a final grade is questioned.

Transferring Policies
Transferring Credits from Non-Pratt PhD Programs at Duke University
If a student has completed the preliminary exams for their PhD outside of a Pratt School of Engineering Department at Duke University, they will be allowed to waive up to two courses in the MEng Program if at least two courses taken for their PhD fulfill requirements for the MEng major of interest. Thus, a student can receive the MEng degree by completing eight additional courses and the internship/project/equivalent requirement. Admission to the MEng Program is separate from admission to the student’s PhD program.

Transferring Credits from The Fuqua School of Business into the MEng Program
If a student has completed the Fuqua MBA course requirements, they will be allowed to waive the two core industry prep courses in the MEng Program. Thus, a student can receive the MEng degree by completing eight additional courses, the internship/project/equivalent requirement. Admission to the MEng Program is separate from admission to The Fuqua School of Business.

Transferring Credits from Other Universities
The MEng degree program requires the successful completion of ten courses (30.0 credits) at Duke. Curricula meeting MEng degree requirements are specified by the student’s MEng degree program and in consultation with the DMS of that program. If a student has taken graduate courses at another university that were not used for that degree, these courses may be used to fulfill course requirements (but not credit requirements) for the Duke MEng degree. Otherwise, the transfer of credits for courses from other universities is not allowed, unless under the terms of an external agreement, as described below.

Duke University or the Pratt School of Engineering may enter into external agreements, similar to the interinstitutional agreement, with local North Carolina Universities that allow courses taken at other universities to count toward the degree. For more information, visit registrar.duke.edu/interinstitutional-duke-students-visiting-other-campuses.

In general, under such agreements, courses that transfer should be taken after matriculation to Duke University. A maximum of 4 courses (12.0 credits) may transfer. Additionally, students transferring credits from other universities must complete at least 6 courses (18.0 credits) through Duke University.

Prior to registering for any non-Duke course to be applied to the MEng degree, students must obtain course-transfer approval from the DMS and a faculty member whose teaching relates to the technical area of the course.

Students may be required to pay a study abroad fee for the semester away from Duke.

Transferring into Pratt’s Professional Master’s Programs from The Graduate School (MS/PhD to MEM or MEng)
Students may transfer into professional master’s programs offered by the Pratt School of Engineering from The Graduate School with the approval of The Graduate School, the original program, and the new program. Students desiring a transfer must submit the following materials to the Professional Master’s Programs office:
- a signed Pratt School of Engineering’s Professional Master’s Transfer Form; and
- an Apply Yourself application (application fee is waived).

Students may be able to transfer some Graduate School application documents to the Pratt School of Engineering. To request the release of these documents, please submit the Authorization and Consent to Release of Educational Record Form to The Graduate School. If original letters of recommendation are not available, the student may request Letters of Recommendation from their current program.

Generally, if a student is leaving the MS or PhD degree and will not earn the full degree, the credits will transfer with grades that will count toward the professional master’s program grade point average.

Transferring within Pratt’s Professional Master’s Programs (MEM to MEng or MEng to MEM)
Students may transfer between professional master’s programs offered by the Pratt School of Engineering with the approval of the original program and the new program. If the transfer is approved, students must submit a signed Pratt School of Engineering Professional Master’s Transfer Form to the student records coordinator for processing.

Transferring from Pratt’s Professional Master’s Programs to The Graduate School (MEM or MEng to MS/PhD)
Students transferring from professional master’s programs offered by the Pratt School of Engineering to The Graduate School should follow The Graduate School’s application process (gradschool.duke.edu/admissions). If transcripts, letters of recommendation, or
other application information need to be forwarded to The Graduate School, please fill out the Authorization and Consent to Release of Educational Record Form and submit it to the Professional Master’s Programs office.

**Transferring between MEng Program and MEng Online**

Students must be approved to transfer between the campus MEng Program and the MEng Online Programs offered in the Artificial Intelligence for Product Innovation, Cybersecurity, and Financial Technology disciplines. The MEng Online degree is designed as a separate program distinctly targeted to working professionals with industry experience. Only on an exceptional basis for compelling reasons will a student be allowed this option. The student must meet with and be approved by the DMS for the online program. Similarly, MEng Online students wanting to transfer to the campus MEng Program must meet with and be approved by the DMS for the campus MEng Program.

**Undergraduate-Level Courses**

Courses below the graduate level, typically below the 500 level, may not be applied toward the required credits needed for the MEng degree. With the approval of the instructor of the undergraduate course, the director of master’s studies, and the associate dean for master’s programs, students may enroll in lower-level courses, but these courses will not count toward any graduation requirement and will not be included in a student’s GPA calculation.

**Withdrawal, Involuntary Administrative**

Students who exhibit harmful, potentially harmful, or disruptive behavior toward themselves or others may be subject to involuntary administrative withdrawal from the university if their behavior renders them unable to effectively function in the university community. Such behavior includes, but is not limited to, that which

- poses a significant threat of danger and/or harm to self and/or other members of the university community, and/or
- interferes with the lawful activities or basic rights of other students, university employees, or visitors.

Any member of the university community who has reason to believe that a student may meet the standard for an involuntary administrative withdrawal may contact the vice president for Student Affairs or their designee. The vice president or designee will conduct a preliminary review in consultation with professionals from Student Health and/or Counseling and Psychological Services, the associate dean of master’s program, and/or other relevant individuals. The vice president or designee will meet, when possible, with the student in question to discuss the information that has been presented and give the student an opportunity to respond. The vice president or designee may mandate that the student be evaluated by a specified health professional within a given time frame if an evaluation has not already been conducted. In the instances described above the vice president for Student Affairs or designee will make the final decision about involuntary administrative withdrawal. A written statement citing the reasons will be forwarded to the associate dean of master’s program, who will withdraw the student from the university. At any point in the process the student may request a voluntary withdrawal via the associate dean of master’s program.
Certificate Programs

The Pratt School of Engineering offers rigorous standalone and concurrent graduate certificate programs that recognize students for work in leading-edge areas of multidisciplinary research. These certificate programs provide graduate students with advanced training in interdisciplinary or emerging fields of knowledge.

Standalone certificates are designed for individuals who are not currently or have not previously been enrolled in a Pratt master’s program but are seeking to strengthen their professional skills. Pratt’s standalone certificates also serve as a strong foundation for individuals who may consider pursuing an advanced degree in an engineering field, and the credits earned from this credential may be applied to appropriate Pratt master’s programs. Students enrolled in standalone certificate programs are subject to the Duke Community Standard and Pratt School of Engineering academic standards.

Concurrent certificates are not standalone and cannot be earned independent of the student’s degree. A student must be enrolled in a graduate degree program prior to enrolling in a certificate program. If a student completes the concurrent certificate’s requirements, it will only be awarded when the primary graduate degree is also completed. A concurrent certificate will not be awarded if the student does not complete their primary graduate degree, even in the case that the certificate’s requirements have been met. Students do not incur additional tuition or fees for a concurrent certificate program.

Additional information regarding application processes, deadlines, and curriculum requirements for each certificate program is available on the certificate’s website.

Standalone Graduate Certificate Programs

Artificial Intelligence Foundations for Product Innovation Certificate
This standalone, credit-bearing program is designed for working professionals in STEM fields who seek to gain AI skills that may be applied to their organization or industry. The Artificial Intelligence Foundations for Product Innovation graduate certificate requires the completion of four core Master of Engineering in Artificial Intelligence for Product Innovation program online courses (12.0 course credits). In addition to the four core courses, certificate students are required to participate in a Python programming bootcamp.

Business Foundations for Engineers Certificate
The Master of Engineering Management Program sponsors a Business Foundations for Engineers graduate certificate. This standalone, credit-bearing program provides experienced STEM professionals with a foundational business education in a technical context. The certificate program enables working technical professionals to cultivate a competitive advantage by building skills in the domains of marketing, finance, management, and law. The Business Foundations for Engineers graduate certificate is designed for working professionals and requires completion of the four core EGRMGMT online courses (12.0 course credits).

Concurrent Graduate Certificate Programs
The Pratt School of Engineering offers rigorous graduate certificate programs that recognize students for work in leading-edge areas of multidisciplinary research. These certificate programs provide graduate students with advanced training in interdisciplinary or emerging fields of knowledge. The student’s official Duke University transcript notes the certificate. These concurrent certificates are not standalone and cannot be earned independent of the student’s degree. A student must be enrolled in a graduate degree program prior to enrolling in a certificate program, and a certificate will not be awarded if the student does not complete their primary graduate degree. Additional information regarding application processes and curriculum requirements for each certificate program is available at pratt.duke.edu/grad/phd/certificates-training:

- Aerospace Certificate (Studies and Opportunities in Aerospace Research - SOAR)
- Biomedical Data Science Certificate
- Biotechnology Certificate
- Medical Device Design Certificate
- Neural Engineering Certificate
Early Career Program and 4+1 Program for Duke Students

Early Career Program
Recent graduates of a Duke University bachelor’s degree program can apply for the Early Career Program up to five years after graduation.

Students enrolled in the Early Career Program will follow the standard application deadlines. Admission must be approved by the department/program in which the master’s degree is sought and by the Pratt School of Engineering. Applicants are not required to take the GRE and are not charged an application fee.

Recent graduates who have unused graduate-level (at the 500 level or above) elective credits as part of their undergraduate degree can transfer up to 4 courses.

4+1 Program for Duke Students
Advanced Duke undergraduates may participate in a 4+1 Program where both a bachelor’s degree and a MEM/MEng degree may be completed in about five years. In the 4+1 Program, students may typically apply up to four graduate courses (at the 500 level or above) that were taken during their undergraduate career but not used to fulfill undergraduate degree requirements toward master’s degree requirements.

To be considered for the 4+1 program, undergraduates may apply for a MEM/MEng admission decision during the standard admission cycle for entrance. Applicants are not required to take the GRE and are not charged an application fee. Students should plan to apply in the semester before admission:

- apply in the spring of junior year for admission in the fall semester of senior year; or
- apply in the fall of senior year for admission in the spring semester senior year.

Admission decisions will be made and communicated to the student following the published admissions decision calendar. Although an admission decision may be made before or during the student’s senior year, matriculation into the MEM/MEng Program will generally not occur until the undergraduate degree has been earned. Matriculation will occur in Summer Session 1 after the spring semester of the senior year unless a student opts for the 4+1 deferred enrollment option. Therefore, students will pay undergraduate tuition for the first four years of study and will pay Pratt tuition for the fifth year of study. The 4+1 deferred enrollment option allows a student to defer enrollment for up to 3 years.

MEM and MEng courses are not typically available to undergraduates. Undergraduate 4+1 students work with the student records coordinator to register for courses. Not all graduate-level courses are available to undergraduates, and registration will only be provided for approved courses. If a 4+1 student desires to take graduate-level elective classes that are not available to undergraduates, they should plan to take these courses in the fifth year of study.

The following rules apply when transferring graduate courses taken as an undergraduate:

- a maximum of four graduate-level courses may be transferred to the MEM/MEng degree
- transferred courses may not have been used to fulfill any undergraduate degree requirements
- transferred courses must fulfill MEM/MEng degree requirements in the major of interest
- a grade of B or better must have been earned in the course
- grades earned are not used to calculate the MEM/MEng GPA

To transfer course credit, students must complete the Pratt Credit Transfer Form and obtain approval from their undergraduate dean and the program director of the master’s program.

For 4+1 students in the Trinity College of Arts & Sciences, additional undergraduate courses may be required as prerequisites in addition to master’s program requirements. It is suggested that 4+1 students discuss their program of study with the program director to understand the expectations in earning the degree. Depending on the extent of the prerequisite courses required, it may not be possible to complete the master’s degree in only one additional year.
All Programs

E-AEROSP-C - Aerospace Certificate

Program Summary

Title
Aerospace Certificate

Degree Designation
CER - Certificate

Type
Certificate

Overview

Professor Robert Kielb, *Director of Certificate Program, Associate Professor of the Practice of Mechanical Engineering and Materials Science*

The Department of Mechanical Engineering and Materials Science offers the Studies and Opportunities in Aerospace Research (SOAR) graduate certificate. Students in MEMS graduate programs can expand their learning experience through this certificate. In research groups and courses, the program educates future leaders in engineering to enable the development of high performance and ultra-efficient aircraft, including drones and UAVs. Reduced emissions, noise, and vibration are also important goals for the program’s team. The globally recognized faculty within the SOAR certificate program are experts in structures and dynamics, aerodynamics, acoustics, and mathematical and computational methods. This certificate is open to students in the MEMS Master of Engineering (MEng), Master of Science (MS), or PhD programs.

Website: [mems.duke.edu/masters/certificates/aerospace](http://mems.duke.edu/masters/certificates/aerospace)

Requirements

Free Form Requirements

- Four technical courses
- Attend four aerospace seminars
- Aerospace research presentation delivered to program faculty
E-AIPI-C - AI Foundations for Product Innovation Certificate

Program Summary

Title
AI Foundations for Product Innovation Certificate

Degree Designation
CER - Certificate

Overview
This standalone, credit-bearing program is designed for working professionals in STEM fields who seek to gain AI skills that may be applied to their organization or industry. The Artificial Intelligence Foundations for Product Innovation graduate certificate requires the completion of four core Master of Engineering in Artificial Intelligence for Product Innovation program online courses (12.0 course credits). In addition to the four core courses, certificate students are required to participate in a Python programming bootcamp.

Admissions Policies and Practices
The certificate program is open to all qualified applicants worldwide. Applications are accepted for the certificate program for the fall semester only. However, applicants enrolled in another Duke graduate program at the time of application may also apply for admission into the certificate program in spring or summer. Admission to the Artificial Intelligence Foundations for Product Innovation graduate certificate program requires the following:

- a bachelor’s degree in engineering or science from an accredited institution (transcripts required, including an estimated GPA and a grade scale) or a bachelor’s degree in any field with equivalent technical work experience;
- statement of purpose;
- résumé;
- two recommendations;
- English Language Testing (TOEFL or IELTS): official results required (international applicants only); and
- video introduction.

Application Deadlines
Students who enroll and successfully complete the certificate requirements will have the option to subsequently apply for the Master of Engineering in AI for Product Innovation Online Program within four years and use their certificate courses (12.0 course credits) toward the degree (30.0 course credits) as long as they earn a grade of B or better in each class. Certificate holders who apply to the MEng in Artificial Intelligence for Product Innovation Online Program will additionally be required to provide GRE scores (if required at time of application) and complete all course requirements for the degree (e.g., four electives, two Pratt MEng management core courses, and the required on-campus residencies in Durham, NC). International applicants please note that this standalone certificate program does not qualify students for US visa sponsorship.

Website: ai.meng.duke.edu/certificate

Requirements
Free Form Requirements
Students may take up to two certificate courses per semester, depending on course availability. Students also take a Python bootcamp in the summer preceding fall enrollment. Students completing the four courses in good academic standing will receive a designation and an Artificial Intelligence Foundations for Product Innovation certificate. Students are required to participate in a virtual onboarding program and Python bootcamp before their first certificate course.

The four certificate courses are as follows:

- AIPI 510: Sourcing Data for Analytics
- AIPI 520: Modeling Process and Algorithms
- AIPI 530: Optimization in Practice or AIPI 531: Deep Reinforcement Learning Applications
- AIPI 540: Building Products and Deep Learning
E-BIOTEK-C - Biotechnology Certificate

Program Summary

Title
Biotechnology Certificate

Degree Designation Type
CER - Certificate Certificate

Overview
The Department of Biomedical Engineering offers a certificate in biotechnology. This certificate provides BME master’s students with in-depth knowledge of cutting-edge techniques for modeling, analyzing, and designing molecular and cellular systems. Working with faculty who are leaders in the field, students will gain hands-on experience in molecular biology, protein expression and purification, and gene editing. This certificate is ideal preparation for careers in the fast-growing biotech industry. This certificate is open to students in the BME Master of Engineering (MEng) or Master of Science (MS) programs.

Website: bme.duke.edu/masters/certificates/biotech

Requirements

Free Form Requirements
Select four courses, including at least one that has labs (denoted by the letter L in the course number):

- BME 562 Biology by Design
- BME 570L Introduction to Biomolecular Engineering
- BME 577 Drug Delivery
- BME 590L Biotechnology Design 1
- BME 590L Biotechnology Design 2
- BME 590L Gene Engineering Lab
- BME 590 Synaptic Biology Synthetic Technology
- BME 790 Bioconjugation in Biomaterials
- BME 790L Bioconjugation Lab
E-BUSFDN-C - Business Foundations for Engineers Certificate

Program Summary

Title
Business Foundations for Engineers Certificate

Degree Designation
CER - Certificate

Type
Certificate

Overview
The Master of Engineering Management Program sponsors a Business Foundations for Engineers graduate certificate. This standalone, credit-bearing program provides experienced STEM professionals with a foundational business education in a technical context. The certificate program enables working technical professionals to cultivate a competitive advantage by building skills in the domains of marketing, finance, management, and law. The Business Foundations for Engineers graduate certificate is designed for working professionals and requires completion of the four core EGRMGMT online courses (12.0 course credits).

Admissions Policies and Practices

The certificate program is open to all qualified applicants worldwide. Students who have passed Calculus I, Calculus II, Calculus III, Statistics, or other math course beyond Calculus II among other technical electives during their undergraduate coursework will be best prepared for the academic rigor of the certificate program.

Applications are accepted for the certificate program for both the fall and spring semesters. Admission to the Business Foundations for Engineers Graduate Certificate Program requires the following:

- a bachelor’s degree in engineering or science from an accredited institution (transcripts required, including an estimated GPA and a grade scale);
- statement of purpose;
- résumé;
- two recommendations;
- English Language Testing (TOEFL or IELTS): official results required (international applicants only);
- a nonrefundable application fee of $75 USD to be paid via credit card; and
- an interview.

Application Deadlines

Students apply in accordance with existing application deadlines for the campus and online MEM programs.

Students who enroll and successfully complete the certificate requirements will have the option to subsequently apply for the Master of Engineering Management Online Program (MEM Online) within four years and use their certificate courses (12.0 course credits) toward the degree (30.0 course credits) as long as they earn a grade of B or better in each class. Certificate holders who apply to MEM Online will additionally be required to provide GRE scores and complete all course requirements for the degree (e.g., four electives, two internship courses, and three on-campus residencies in Durham, NC). International applicants please note that this stand-alone certificate program does not qualify students for US visa sponsorship.

Website: mem.pratt.duke.edu/certificate

Requirements

Free Form Requirements

Students may take up to two certificate courses. Certificate courses are not offered in the summer terms. Students completing the four courses in good academic standing will receive a designation and a Business Foundations for Engineers certificate. Students are required to participate in a virtual onboarding program before their first certificate course.

The four certificate courses are:

- EGRMGMT 510: Marketing (only offered in the fall)
- EGRMGMT 520: Intellectual Property, Business Law, and Entrepreneurship (only offered in the spring)
- EGRMGMT 530: Finance in High Tech Industries (only offered in fall)
- EGRMGMT 540: Management of High Tech Industries (only offered in spring)
E-DATSCI-C - Biomedical Data Science Certificate

Program Summary

Title
Biomedical Data Science Certificate

Degree Designation
CER - Certificate

Type
Certificate

Overview
Professor Sina Farsiu, Director of Certificate Program, Assistant Professor of Biomedical Engineering

Biomedical engineering has become a prime discipline for applying data science techniques—and the job market for biomedical engineers with data science skills is expanding rapidly. With its pioneering expertise and leadership in biomedical engineering, machine learning, signal and image processing, and biostatistics, Duke is the ideal place to learn how to translate biomedical data into actionable health insights. By collaborating with and learning from leading researchers, students who earn a Biomedical Data Science Certificate can increase their competitiveness for positions in industry and doctoral programs.

Enrollment in the four-course Master's Certificate in Biomedical Data Science is open to all Duke Master of Engineering (MEng) and Master of Science (MS) students intending to pursue careers or enter doctoral programs relating to biomedical data science.

Website: bme.duke.edu/masters/certificates/biomedical-data-science

Requirements

Free Form Requirements
- Complete all departmental requirements for a master's degree
- Complete at least four (4) of the approved courses relevant to data science. At least two (2) of these courses must be offered through Duke BME
- Complete a biomedical data science-relevant project and submit a two-page abstract and poster to the Biomedical Data Science Committee. The project could result from previous course projects, independent study, or a master's thesis. It must have a non-trivial technical novelty and demonstrate proficiency in developing novel methodologies or scientifically utilizing a broad range of advanced data science tools to solve impactful biomedical problems.

E-EGR-AIPI - Master of Engineering in Artificial Intelligence for Product Innovation

Program Summary

Title
Master of Engineering in Artificial Intelligence for Product Innovation

Degree Designation
ME - Master of Engineering

Type
Primary

Overview
Students in the MEng AI for Product Innovation program develop strong technical skills together with an understanding of product design. After graduation students are well-equipped to design and develop AI-based products and systems within large companies or through their own entrepreneurial ventures. Graduates go on to work in leading companies solving difficult problems across many industries, such as tech, healthcare, energy, retail, transportation and finance.

Through the program, students will learn to:
- Identify and assess opportunities for the application of AI/ML in products
- Design data pipelines and ML systems for scale, security and usability
- Apply traditional ML and deep learning models to solve challenging problems across domains
- Build full-stack software applications integrating machine learning models utilizing the latest methods and technologies

Innovative and immersive, this master's degree can be completed in 12 or 16 months on-campus.
Duke University

Website: ai.meng.duke.edu/degree

Requirements
Free Form Requirements

- **Pre-Program Preparation**
  - AIPI 503: Python Programming Boot Camp

- **Technical Core**
  - AIPI 510: Sourcing Data for Analytics
  - AIPI 520: Modeling Process & Algorithms
  - AIPI 530: Optimization in Practice or AIPI 531: Deep Reinforcement Learning Applications
  - AIPI 540: Deep Learning Applications

- **AI Operations Core**
  - AIPI 501: Industry Seminar Series
  - AIPI 560: Legal, Societal & Ethical Implications of AI
  - AIPI 561: Operationalizing AI (MLOps)

- **Management Core**
  - MENG 540: Management of High-Tech Industries
  - MENG 570: Business Fundamentals for Engineers

- **Elective Options.** In addition to the courses listed below, students in this master's degree program may take other graduate-level elective courses within Duke's Pratt School of Engineering, on a space-available basis with instructor permission.
  - **ML Engineering Track**
    - AIPI 590: Data Analysis at Scale in the Cloud
    - AIPI 531: Deep Reinforcement Learning Applications
    - ECE 564: Mobile App Development
    - EGRMGT 590-03: Software, Solution & Enterprise Architecture
    - EGRMGT 590-05: Software Business Management
    - CYBERSEC 511: Cybersecurity in the Software Development Lifecycle
    - CYBERSEC 520: Applying Machine Learning to Advance Cybersecurity
    - EGRMGT 575: Software Quality Management
  - **Data Science Track**
    - BME 580: Biomedical Data Science
    - BIOSTAT 709: Observational Studies
    - EGRMGT 590-05: Software Business Management
    - STA 640: Causal Inference
    - STA 663: Statistical Computation
    - ECE 682D: Probabilistic Machine Learning

- **Capstone Project**
  - AIPI 549: Capstone Project

- **Internship or Project**
  - MENG 550: Master of Engineering Internship or Project
  - MENG 551: Master of Engineering Internship or Project Assessment

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E-EGR-AIPO - Master of Engineering in Artificial Intelligence for Product Innovation—Online

Program Summary

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Overview

Students in the MEng AI for Product Innovation program develop strong technical skills together with an understanding of product design. After graduation, students are well-equipped to design and develop AI-based products and systems within large companies or through their own entrepreneurial ventures. Graduates go on to work in leading companies solving difficult problems across many industries, such as tech, healthcare, energy, retail, transportation, and finance.

Through the program, students will learn to:
- Identify and assess opportunities for the application of AI/ML in products
- Design data pipelines and ML systems for scale, security, and usability
- Apply traditional ML and deep learning models to solve challenging problems across domains
- Build full-stack software applications integrating machine learning models utilizing the latest methods and technologies

Innovative and immersive, this master's degree can be completed online part-time in just 24 months.

Website: ai.meng.duke.edu/degree

Requirements

Free Form Requirements

- Pre-Program Preparation
  - AIPI 503: Python Programming Boot Camp

- Technical Core
  - AIPI 510: Sourcing Data for Analytics
  - AIPI 520: Modeling Process & Algorithms
  - AIPI 530: Optimization in Practice or AIPI 531: Deep Reinforcement Learning Applications
  - AIPI 540: Deep Learning Applications

- AI Operations Core
  - AIPI 551: Industry Seminar Series
  - AIPI 560: Legal, Societal, & Ethical Implications of AI
  - AIPI 561: Operationalizing AI (MLOps)

- Management Core
  - MENG 540: Management of High-Tech Industries
  - MENG 570: Business Fundamentals for Engineers

- Elective Options. In addition to the courses listed below, students in this master's degree program may take other graduate-level elective courses within Duke's Pratt School of Engineering, on a space-available basis with instructor permission.
  - **ML Engineering Track**
    - AIPI 590: Data Analysis at Scale in the Cloud
    - AIPI 531: Deep Reinforcement Learning Applications
    - ECE 564: Mobile App Development
    - EGRMGMT 590-03: Software, Solution & Enterprise Architecture
    - EGRMGMT 590-05: Software Business Management
    - CYBERSEC 511: Cybersecurity in the Software Development Lifecycle
    - CYBERSEC 520: Applying Machine Learning to Advance Cybersecurity
    - EGRMGMT 575: Software Quality Management
  - **Data Science Track**
    - BME 580: Biomedical Data Science
    - BIOSTAT 709: Observational Studies
    - EGRMGMT 590-05: Software Business Management
    - STA 640: Causal Inference
    - STA 663: Statistical Computation
    - ECE 682D: Probabilistic Machine Learning

- Capstone Project
E-EGR-BME - Master of Engineering in Biomedical Engineering

Program Summary
Title
Master of Engineering in Biomedical Engineering
Degree Designation
ME - Master of Engineering
Type
Primary
Overview
The 30-credit Duke Master of Engineering in Biomedical Engineering provides a unique combination of opportunities:
- A respected and highly-ranked graduate program
- Engineering and business courses plus an internship
- Access to graduate certificate programs in high-demand career areas
- Dedicated career support
- A track record of positive career outcomes

Website: bme.duke.edu/masters/degrees/meng-bme

Requirements
Free Form Requirements
30 course credits, with industry internship
- Core Industry Preparation Courses—6 credits
  - Master of Engineering 540 (Management of High Tech Industries)
  - Master of Engineering 570 (Business Fundamentals for Engineers)
- Life Science course—3 credits
- Advanced Mathematics course—3 credits
- BME courses—9 credits
- Technical Electives in a Concentration Area—9 credits
- Industry Internship—0 credits
  - Master of Engineering 550 (Master of Engineering Internship/Project)
  - Master of Engineering 551 (Master of Engineering Internship/Project Assessment)

E-EGR-CE - Master of Engineering in Civil Engineering

Program Summary
Title
Master of Engineering in Civil Engineering
Degree Designation
ME - Master of Engineering
Type
Primary
Overview

Campus Residencies
Online students attend three (3) week-long on-campus residencies
Duke University

Duke’s Master of Engineering (MEng) in Civil Engineering is a career-focused degree option that will deepen your understanding of technology and help you develop the business leadership and management expertise you need to succeed in your career.

Website: cee.duke.edu/grad/masters#meng

Requirements

Free Form Requirements
Master of Engineering students complete the Core Industry Preparatory Courses and Internship, Departmental Requirements, and will choose specialization requirements of four courses from our areas of concentration.

Summary
The curriculum, detailed below, includes:

- 30 course credits
- 1 Seminar
- Internship

30 Course Credits
The Master of Engineering in Civil Engineering is a 30-credit degree distributed as follows:

- Core Industry Preparation Courses (6 credits)
- Departmental Requirements (12 credits)
- Degree Concentration Area Requirements (6 credits)
- Technical Electives (6 credits)
- Internship, Applied Research Experience, or Project (0 credits)

CE Curriculum Notes
1. At the beginning of their program, each student will be required to propose and gain approval from the Director of Master’s Studies (DMS) for a specific curriculum that satisfies the requirements for the MEng degree in Civil Engineering as specified below.
2. At least fifteen credits must be taken from the Pratt School of Engineering.

Overview

Core Industry Preparation Course Requirements (6 credits)

- MENG 540: Management of High Tech Industries
- MENG 570: Business Fundamentals for Engineers

Departmental Requirements (12 credits). All students are required to take four courses from the following list of departmental requirements:

- CEE 520: Continuum Mechanics
- ME 541/CE 625: Intermediate Dynamics
- CEE 647: Buckling of Engineering Structures
- CEE 530: Introduction to Finite Elements
- CEE 643: Environmental and Engineering Geophysics
- CEE 541: Structural Dynamics

Concentration Areas. All students must take two courses from one of the following three concentration areas:

- Computational Engineering
  - CEE 621: Plasticity
  - CEE 630: Nonlinear Finite Element Analysis
  - CEE 635: Computational Methods for Evolving Discontinuities
  - MATH 563: Scientific Computing II
  - MATH 661: Numerical Solution of Hyperbolic Partial Differential Equations
  - MATH 663: Numerical Solution of Elliptic and Parabolic Partial Differential Equations
  - ME 639: Computational Fluid Mechanics and Heat Transfer
Technical Electives (6 Credits). Technical Electives provide flexibility to the program while developing additional depth in a direction of student interest. A Technical Elective can be any graduate level course, consistent with the plan of study and approved by the DMS. The order of preference in approving technical electives is:

1. Other courses from departmental requirements or degree concentration areas.
2. Courses in mathematics or statistics, such as:
   - MATH 551: Applied Partial Differential Equations and Complex Variables
   - MATH 561: Scientific Computing I
   - STA 611: Introduction to Statistical Methods
3. Other CEE courses
4. Other engineering courses

Internship, Project or Equivalent Requirements

- MENG 550: Internship or Applied Research Project
- MENG 551: Internship/Project Assessment

E-EGR-CMSC - Master of Engineering in Computational Mechanics and Scientific Computing

Program Summary

Title
Master of Engineering in Computational Mechanics and Scientific Computing

Degree Designation Type
ME - Master of Engineering Primary

Overview

Duke’s Master of Engineering in Computational Mechanics and Scientific Computing is one of the most comprehensive in the world—and features a top-notch faculty.

Increasingly, engineering systems are being designed and tested virtually. The successful use of model-based simulation in modern applications requires a solid background in engineering physics, computer science, probability, data sciences, and applied mathematics. This Master of Engineering program provides a strong foundation in all of these areas.
The program emphasizes the use and development of modern numerical tools for model-based simulations such as finite element methods, uncertainty quantification procedures, and data analysis techniques, among others. We offer a large number of core and elective courses in finite element methods for applications in solid mechanics, fluid mechanics, and coupled field problems.

In the Duke Master of Engineering program, you take specialized technical classes and a core of business leadership and management courses, with a required internship or a project completing the degree.

Website: cee.duke.edu/grad/masters/meng-computational-mechanics

### Requirements

#### Free Form Requirements

I. Core Requirements (6 credits / 2 courses)
- MENG 540: Management of High Tech Industries (3 credits)
- MENG 570: Business Fundamentals for Engineers (3 credits)

II. Proseminar (0.0 credits / 1 course)
- CE 703 / ME 703: Industrial Colloquia in Computational Mechanics and Scientific Computing

III. Finite Element Methods (6 credits / 2 courses)
- CE 530 / ME 524: Introduction to the Finite Element Method
- CE 630 / ME 525: Nonlinear Finite Element Method

IV. Applied Math/Statistics (3 credits / 1 course from list)
- Math 561: Numerical Linear Algebra
- Math 541: Applied Stochastic Processes
- Math 551: Applied Differential Equations and Complex Variables

V. Computer Science (3 credits / 1 course from list)
- CS 590: Parallel Computing
- ECE 551D: Programming, Data Structures, and Algorithms in C++

VI. Application Areas (4 of any courses from three areas of concentration, 12 credits)
- Mechanics of Materials
  - CEE 520: Continuum Mechanics
  - CEE 541: Structural Dynamics
  - ME 555: Computational Materials Science
  - CEE 622: Fracture Mechanics
- Fluid Mechanics
  - CEE 531: Finite Element Methods for Problems in Fluid Mechanics
  - ME 572: Engineering Acoustics
  - ME 639: Computational Fluid Mechanics and Heat Transfer
  - CEE 690: Turbulence
- Optimization / Data Analytics
  - CS 445/MATH 465: Intro to High Dimensional Data Analysis
  - CE 522/ME 526: Numerical Optimization
  - CS 571D: Machine Learning
  - STA 502: Bayesian Inference and Decision

Other course offerings may be substituted with consent of the Director of Masters Studies.

VII. Internship, Project or Equivalent Requirements (0 credits)
- MENG 550: Internship or Applied Research Project
E-EGR-CYBO - Master of Engineering in Cybersecurity—Online

Program Summary

Title
Master of Engineering in Cybersecurity—Online

Degree Designation
ME - Master of Engineering

Type
Primary

Overview
Cybersecurity is an engineering discipline focused on the protection of computer systems from malicious intrusion, damage, or disruption of the critical services those systems provide.

Duke’s Master of Engineering in Cybersecurity provides the latest knowledge and skills in the practice of cybersecurity—with a focus on developing leaders and management for corporate, academic and public sector cybersecurity teams.

Part-time/online students typically finish 5 semesters and still maintain their life and work priorities.

Website: cybersecurity.meng.duke.edu/degree

Requirements
Free Form Requirements

For all students, the Duke Cybersecurity Master of Engineering degree is 30 credits, including 10 courses:

- Two (2) Industry Preparation Core courses, developed in partnership with Duke’s Law School and Fuqua School of Business
  - MENG 540: Management of High-Tech Industries
  - MENG 570: Business Fundamentals for Engineers
- Three (3) Technical Core courses, developed by Duke Engineering cybersecurity faculty
  - CYBERSEC 500: Introduction to Cybersecurity Perspectives
  - CYBERSEC 502: Multidisciplinary Cybersecurity: Government, Public Policy, Law, and Select Industry Topics
  - CYBERSEC 503: Cybersecurity Risk Management
- Five (5) Cybersecurity Elective courses, to focus and customize your degree
  - Technology Track
    - CYBERSEC 510: Security Incident Detection, Response and Resilience
    - CYBERSEC 511: Cybersecurity in the Software Development Life Cycle
    - CYBERSEC 520: Applying Machine Learning to Advance Cybersecurity
    - CYBERSEC 590.XX: Web3 Engineering & Security
    - FINTECH 510: Programming for FinTech
    - FINTECH 564: Blockchain
  - Technology Management Track
    - CYBERSEC 531: The Human Element in Cybersecurity
    - CYBERSEC 530: Identity and Access Management
    - CYBERSEC 521: Cybersecurity Program Development, Operations & Analysis
    - PUBPOL 551S: Cybersecurity and National Security Law and Policy

Internship or Project

- A required internship is an excellent way to gain valuable experience. Although students are responsible for finding their own internship, Duke provides a dedicated career development team to help.
- Part-time, working students can receive credit for applying what they learn at work, or opt to complete a project

Campus Residencies

- Online students attend three (3) week-long on-campus residencies
E-EGR-CYBS - Master of Engineering in Cybersecurity

Program Summary
Title
Master of Engineering in Cybersecurity

Degree Designation
ME - Master of Engineering

Type
Primary

Overview
Cybersecurity is an engineering discipline focused on the protection of computer systems from malicious intrusion, damage, or disruption of the critical services those systems provide.

Duke’s Master of Engineering in Cybersecurity provides the latest knowledge and skills in the practice of cybersecurity—with a focus on developing leaders and management for corporate, academic and public sector cybersecurity teams.

Full-time/on-campus typically finish in 3 semesters and still maintain their life and work priorities.

Website: cybersecurity.meng.duke.edu/degree

Requirements
Free Form Requirements
Courses
For all students, the Duke Cybersecurity Master of Engineering degree is 30 credits, including 10 courses:

- Two (2) Industry Preparation Core courses, developed in partnership with Duke’s Law School and Fuqua School of Business
  - MENG 540: Management of High-Tech Industries
  - MENG 570: Business Fundamentals for Engineers
- Three (3) Technical Core courses, developed by Duke Engineering cybersecurity faculty
  - CYBERSEC 500: Introduction to Cybersecurity Perspectives
  - CYBERSEC 502: Multidisciplinary Cybersecurity: Government, Public Policy, Law, and Select Industry Topics
  - CYBERSEC 503: Cybersecurity Risk Management
- Five (5) Cybersecurity Elective courses, to focus and customize your degree
  - Technology Track
    - CYBERSEC 510: Security Incident Detection, Response and Resilience
    - CYBERSEC 511: Cybersecurity in the Software Development Life Cycle
    - CYBERSEC 520: Applying Machine Learning to Advance Cybersecurity
    - CYBERSEC 590.XX: Web3 Engineering & Security
    - FINTECH 510: Programming for FinTech
    - FINTECH 564: Blockchain
  - Technology Management Track
    - CYBERSEC 531: The Human Element in Cybersecurity
    - CYBERSEC 530: Identity and Access Management
    - CYBERSEC 521: Cybersecurity Program Development, Operations & Analysis
    - PUBPOL 551S: Cybersecurity and National Security Law and Policy

Internship or Project
- A required internship is an excellent way to gain valuable experience. Although students are responsible for finding their own internship, Duke provides a dedicated career development team to help.
- Part-time, working students can receive credit for applying what they learn at work, or opt to complete a project

Workshop Series
- On-campus students participate in three (3) seminar and workshop series
E-EGR-ECE - Master of Engineering in Electrical and Computer Engineering

Program Summary

Title
Master of Engineering in Electrical and Computer Engineering

Degree Designation
ME - Master of Engineering

Type
Primary

Overview
The Duke ECE Master of Engineering degree provides a unique combination of advantages:

- **Interdisciplinary training** that develops technical knowledge plus business skills
- **Flexible, individualized curriculum** oriented around high-demand fields
- **Industry internship** plus professional development support
- **Excellent career outcomes**, and a global alumni network
- **Part-time option**—Perfect for working professionals

Website: ece.duke.edu/masters/degrees/meng

Requirements

Free Form Requirements

Core Industry Preparation Courses (6 credits)
- MENG 540: Management of High-Tech Industries
- MENG 570: Business Fundamentals for Engineers

ECE Concentration Area Courses (9 credits)
Choose three (3) courses from any one (1) discipline. A custom course plan may also be developed with the approval of the student's advisor.

Select a study area to see related courses:
- Software Development
- Hardware Design
- Data Analytics & Machine Learning
- Quantum Computing
- Microelectronics, Photonics and Nanotechnology
- Design Your Own ECE Degree

Technical and General Electives (15 credits)
- Technical electives (6 credits): Choose two courses from ECE or other approved technical areas.
- General electives (9 credits): With the approval of the student's advisor and the DGS, choose any three elective courses.

Internship, Project or Equivalent (0 credits)
- MENG 550: Internship or Applied Research Project
- MENG 551: Internship/Project Assessment

E-EGR-ENV - Master of Engineering in Environmental Engineering

Program Summary

Title
Master of Engineering in Environmental Engineering

Degree Designation

Type
**Overview**

The challenge of sustainable environmental quality requires innovative thinking, clear leadership and strong technical expertise. Duke’s Master of Engineering in Environmental Engineering is ranked a Top 15 program in the United States. We will give you the comprehensive training you need to become a leader in protecting natural resources.

Our program draws from Duke’s Pratt School of Engineering and Nicholas School of the Environment—so you get the best of our renowned engineering and environmental research community.

Coursework draws on recent research by our world-class faculty, many of whom are involved in major federally-funded research centers such as the Superfund Research Center at Duke.

**Specializations**

- Environmental Data Science
- Environmental Engineering and Public Policy
- Environmental Health Engineering
- Hydrology & Environmental Fluid Dynamics

**Website**: cee.duke.edu/grad/masters#meng

**Requirements**

**Free Form Requirements**

**Summary**

Master of Engineering (MEng) students complete the Core Industry Preparatory Courses and Internship, Departmental Requirements, and choose specialization requirements of (4) four courses.

The curriculum, detailed below, includes:

- 30 course credits
- 1 Seminar
- Internship

**Curriculum Overview**

The Master of Engineering in Environmental Engineering is a 30-credit degree distributed as follows:

- **Core Industry Preparation Courses** (6 credits)
  - MENG 540: Management of High Tech Industries
  - MENG 570: Business Fundamentals for Engineers

- **Departmental Requirements** (15 credits, with at least 1 course each from 5 of the 6 following categories)
  - **Chemistry**
    - CEE 561: Environmental Aquatic Chemistry
    - CEE 563: Chemical Fate of Organic Compounds
    - CEE 565: Environmental Analytical Chemistry
    - CEE 666: Aquatic Geochemistry
    - CEE 667: Chemical Transformations of Environmental Contaminants

  - **Biosciences**
    - CEE 566: Environmental Microbiology
    - CEE 661L: Environmental Molecular Biotechnology
    - CEE 562: Biological Processes in Environmental Engineering

  - **Applied Mathematics, Statistics & Data Science**
    - CEE 501: Applied Mathematics for Engineers
    - CEE 502: Engineering Data Analysis
    - CEE 675: Introduction to the Physical Principles of Remote Sensing of the Environment
- CEE 690: Health and Environmental Data Science
- CEE 690/628: Uncertainty Quantification
- CEE 690/590: Environmental Spatial Data Analysis
- CEE 690: Uncertainty and Risk in Engineering
- ENVIRON 764: Applied Differential Equations in Environmental Science
- STA 601(L): Bayesian and Modern Statistics
- STA 611: Introduction to Statistical Methods

- **Transport Processes & Modeling**
  - CEE 531: Finite Elements for Fluids
  - CEE 560: Environmental Transport Phenomena
  - CEE 581: Numerical Methods in Env Transport
  - CEE 683: Groundwater Hydrology and Contaminant Transport
  - CEE 690: Environmental Fluid Mechanics and Sediment Transport

- **Atmospheric & Hydrologic Processes**
  - ENVIRON 734L: Watershed Hydrology
  - CEE 575/690: Air Pollution Engineering
  - CEE 5XX/690: Hydrology
  - CEE 683: Groundwater and Vadose Zone Hydrology
  - CEE 684: Physical Hydrology and Hydrometeorology
  - CEE 690: Turbulence I
  - CEE 581: Numerical Methods in Env Transport
  - ENVIRON 603 & 604: Air Quality: Management & Human Health Effects

- **Engineered Systems**
  - CEE 564: Physical Chemical Processes in Environmental Engineering
  - CEE 562: Biological Processes in Environmental Engineering
  - CEE 575/690: Air Pollution Engineering

- **Specialization Requirements** (9 credits, with at least 3 courses from a specialization area)
  - **Environmental Data Science**
    - CEE 690: Risk and Resilience in Engineering
    - CEE 690: Health and Environmental Data Science
    - CEE 690: Environmental Cheminformatics
    - CEE 690: Introduction to Deep Learning
    - CEE 690: Environmental Spatial Data Analysis
    - CEE 690: Model-Based Data Science
    - CEE 761: Hydrologic Data Analysis
    - MATH 561: Scientific Computing
    - STA 601(L): Bayesian and Modern Statistics
    - STA 611: Introduction to Statistical Methods
    - ENVIRON 559: Fundamentals of Geographic Information Systems and Geospatial Analysis

- **Environmental Engineering & Public Policy**
  - ENVIRON 502: Climate Change and the Law
  - ENVIRON 520: Resource and Environmental Economics
  - ENVIRON 531: Economic Valuation of the Environment
  - ENVIRON 552: Climate and Society
  - ENVIRON 563: Cost-Benefit Analysis for Health and Environmental Policy
  - ENVIRON 577: Environmental Politics
  - ENVIRON 603: Air Quality Management (1.5 credits)
  - ENVIRON 604: Air Quality: Human Health Effects (1.5 credits)
  - ENVIRON 638: Environmental Life Cycle Analysis and Decision
  - ENVIRON 640: Climate Change Economics and Policy
  - ENVIRON 711: Energy and Environment
Duke University

- EMIRON 740: Water Resources Planning and Management
- EMIRON 741: Water Resources Finance
- PUBPOL 577: Environmental Policy
- PUBPOL 811: Microeconomics: Policy Applications
- PUBPOL 813: Quantitative Evaluation Methods
- ENERGY 727: Energy Law
- **Environmental Health Engineering**
  - CEE 560: Environmental Transport Phenomena
  - CEE 561: Environmental Aquatic Chemistry
  - CEE 562: Biological Processes in Environmental Engineering
  - CEE 563: Chemical Fate of Organic Compounds
  - CEE 564: Physical Chemical processes in Environmental Engineering
  - CEE 565: Environmental Analytical Chemistry
  - CEE 566: Environmental Microbiology
  - CEE 575/690: Air Pollution Engineering
  - CEE 661L: Environmental Molecular Biotechnology
  - CEE 666: Aquatic Geochemistry
  - CEE 667: Chemical Transformations of Environmental Contaminants
  - CEE 679: Environmental Engineering Project Management
  - CEE 5XX/690: Hydrology
  - CEE 690: Risk and Resilience in Engineering
  - CEE 690: Health and Environmental Data Science
  - CEE 690: Environmental Cheminformatics
  - CEE 690: Environmental Spatial Data Analysis
  - EMIRON 603: Air Quality Management (1.5 credits)
  - EMIRON 604: Air Quality: Human Health Effects (1.5 credits)
- **Hydrology & Environmental Fluid Dynamics**
  - CEE 531: Finite Elements for Fluids
  - CEE 560: Environmental Transport Phenomena
  - CEE 581: Numerical Methods in Env Transport
  - CEE 675: Introduction to the Physical Principles of Remote Sensing of the Environment
  - CEE 683: Groundwater Hydrology and Contaminant Transport
  - CEE 684: Physical Hydrology and Hydrometeorology
  - CEE 688: Turbulence I
  - CEE 642: Environmental Geomechanics
  - ME 536: Compressible Fluid Flow
  - ME 631: Intermediate Fluid Mechanics
  - ME 632/CEE690: Advanced Fluid Mechanics
  - ME 639: Computational Fluid Mechanics and Heat Transfer
  - CEE 690: Advanced Turbulence Theories
  - CEE690: Hydrology
  - CEE 690: Environmental Fluid Mechanics and Sediment Transport
  - CEE 690: Health and Environmental Data Science
  - CEE 690/628: Uncertainty Quantification
  - CEE 690: Environmental Spatial Data Analysis
  - EMIRON 734L: Watershed Hydrology
- **Internship, Applied Research Experience or Project (0 credits)**
  - MENG 550: Internship or Applied Research Project
  - MENG 551: Internship/Project Assessment

**Curriculum Notes**
E-EGR-FNTK - Master of Engineering in Financial Technology

Program Summary

Title
Master of Engineering in Financial Technology

Degree Designation
ME - Master of Engineering

Type
Primary

Overview
Financial technology, or FinTech, describes the innovative applications of computer software and networks, and other information technology, on financial institutions and markets. This includes technology enabling digital currencies (such as cryptocurrencies), digital assets, financial process automation, wealth management and trading, robotic advising, payment and transactions, financial data analysis, credit and lending, and much more.

Learn financial technologies and how to apply them—including computing fundamentals, blockchain, digital wallets, cryptocurrency, smart contracts. Our master's students also take courses that build their management and communications skills— for a full professional degree.

The degree can be completed full-time on-campus in 3 semesters.

Website: fintech.meng.duke.edu/degree

Requirements

Free Form Requirements

Industry Preparation Core
- MENG 540: Management of High-Tech Industries
- MENG 570: Business Fundamentals for Engineers

Technical Core
- FinTech
  - FINTECH 501: Seminar and Workshops
- Programming
  - FINTECH 510: Programming for FinTech
  - FINTECH 512: Software Engineering for FinTech
- Finance
  - FINTECH 520: Financial Institution Products & Services
  - FINTECH 522: Asset Pricing and Risk Management

Electives
- Technology Track
  - FINTECH 514: Secure Software Development
  - FINTECH 533: Design and Testing of Algorithmic Trading Systems
  - FINTECH 535: Advanced Design and Testing of Algorithmic Trading Systems
  - FINTECH 536: Robo-Advising
  - FINTECH 540: Machine Learning for FinTech
  - FINTECH 545: Quantitative Risk Management
  - FINTECH 564: Blockchain
  - FINTECH 565: Advanced Blockchain - Smart Contacts and Solidity Coding
  - FINTECH 590.XX: Web3 Engineering & Security
E-EGR-FNTO - Master of Engineering in Financial Technology—Online

Program Summary
Title
Master of Engineering in Financial Technology—Online

Degree Designation
ME - Master of Engineering

Type
Primary

Overview
Financial technology, or FinTech, describes the innovative applications of computer software and networks, and other information technology, on financial institutions and markets. This includes technology enabling digital currencies (such as cryptocurrencies), digital assets, financial process automation, wealth management and trading, robotic advising, payment and transactions, financial data analysis, credit and lending, and much more.

Learn financial technologies and how to apply them—including computing fundamentals, blockchain, digital wallets, cryptocurrency, smart contracts. Our master's students also take courses that build their management and communications skill — for a full professional degree.

The degree can be completed online part-time in 5 semesters.

Website: fintech.meng.duke.edu/degree

Requirements
Free Form Requirements

Industry Preparation Core
- MENG 540: Management of High-Tech Industries
- MENG 570: Business Fundamentals for Engineers

Technical Core
- FinTech
  - FINTECH 501: Seminar and Workshops
- Programming
  - FINTECH 510: Programming for FinTech
  - FINTECH 512: Software Engineering for FinTech
- Finance
  - FINTECH 520: Financial Institution Products & Services
  - FINTECH 522: Asset Pricing and Risk Management

Electives
- Technology Track
  - FINTECH 514: Secure Software Development
Duke University

- FINTECH 533: Design and Testing of Algorithmic Trading Systems
- FINTECH 535: Advanced Design and Testing of Algorithmic Trading Systems
- FINTECH 536: Robo-Advising
- FINTECH 540: Machine Learning for FinTech
- FINTECH 545: Quantitative Risk Management
- FINTECH 564: Blockchain
- FINTECH 565: Advanced Blockchain - Smart Contacts and Solidity Coding
- FINTECH 590:XX: Web3 Engineering & Security
- ECE 564: Mobile Application Development
- EGRMGMT 587: Data Visualization

○ Technology Management Track
  - FINTECH 550: Emerging Trends for FinTech Services
  - FINTECH 552: FinTech Business Models
  - EGRMGMT 572: Innovation Management in Tech Organizations
  - LAW 581: FinTech Law and Policy

○ Capstone Project
  - FINTECH 502: FinTech Capstone

○ Internship or Project
  - MENG 550: Master of Engineering Internship or Project
  - MENG 551: Master of Engineering Internship or Project Assessment

Campus Residencies
- Online students attend three (3) week-long on-campus residencies
E-EGR-ME - Master of Engineering in Mechanical Engineering

Program Summary

Title
Master of Engineering in Mechanical Engineering

Degree Designation
ME - Master of Engineering

Type
Primary

Overview
The Duke MEMS Master of Engineering degree provides a unique combination of advantages that only Duke can offer:

- **Interdisciplinary training** in engineering, science and management
- **Flexible, individualized curriculum** combined with required industry internship
- **Three-semester study plans** without a thesis
- **Excellent career outcomes** in industry

The Duke Master of Engineering includes a flexible curriculum of engineering, science and business training over three semesters—about 1.5 years:

- Get rigorous training while developing an engineering specialty of your own design
- Business courses are enhanced by an internship with a leading company

Website: mems.duke.edu/masters/degrees/meng

Requirements

Free Form Requirements

- 2 Industry preparation courses
  - MEng 540: Leadership & Management
  - MEng 570: Business Fundamentals
- 5 Courses in your area of study
- 3 Elective courses
- 1 Internship
  - MEng 550: Internship or Project
  - MEng 551: Internship Assessment
E-EGR-MSE - Master of Engineering in Materials Science and Engineering

Program Summary

Title
Master of Engineering in Materials Science and Engineering

Degree Designation
ME - Master of Engineering

Type
Primary

Overview
The Master of Engineering (MEng) in Materials Science and Engineering is an advanced engineering degree that includes business courses, technical training and an internship.

Website: dmi.duke.edu/degrees/masters

Requirements

Free Form Requirements
Master of Engineering students complete 30 credits, comprised of key program elements as follows:

Core industry preparatory courses
(2 courses, 6 credits)
- MENG 540: Management of High Tech Industries
- MENG 570: Business Fundamentals for Engineers

Discipline-specific or interdisciplinary core courses
(5-6 courses, 15 - 18 credits, varies by department)
The Master of Engineering program in the discipline of materials engineering and science has a defined a set of requirements designed to give you in-depth technical knowledge. Our MSE master’s program gives you flexibility in course selection within your engineering discipline.

Technical electives in a concentrated area
(2-3 courses, 6 - 9 credits, varies by department)
Technical elective options give you more opportunity to specialize in your area of interest, and really take advantage of Duke’s leading status in materials science and engineering. Specializations like these will distinguish you with potential employers. You will work with a faculty advisor to customize a curriculum that suits you. In some cases, an independent study sponsored by a faculty member may satisfy an elective requirement.

Internship
- MENG 550: Master of Engineering Internship/project
- MENG 551: Master of Engineering Internship/project Assessment

We require all MEng students to engage in an internship or project to complete the program. The many options available to fulfill this requirement give you a chance to practice what you’re learning, ask questions and hone your skills in a supportive environment. Internships may be paid or unpaid, corporate or governmental. Projects may take the form of applied research positions, provided the learning objectives are met.

Once your project or internship is completed, you will prepare a written and/or oral project report. Individual programs/majors may have additional requirements or exceptions to fulfill the internship component of the program.
E-EGR-MTD - Master of Engineering in Medical Technology Design

Program Summary

Title
Master of Engineering in Medical Technology Design

Degree Designation
ME - Master of Engineering

Type
Primary

Overview
The market for medical devices worldwide is growing fast. In the United States alone, the MedTech industry is growing by an average US$7 billion a year.

Few universities are as uniquely equipped as Duke to deliver best-in-class master's-level training in medical technology design.

Website: bme.duke.edu/masters/degrees/medtech-design

Requirements

Free Form Requirements
The 30-credit Medical Technology Design Master of Engineering (MEng) prepares graduates for leadership positions industry. A program of 10 courses provides exposure to all phases of medical product development—from needs-finding to product launch.

- Skills Sequence
  - BME 790L: Advanced Design and Manufacturing
  - BME 790L: Medical Electrical Equipment
- Design Health Sequence
  - BME 790L: Design in Health Care 1—Discover
  - BME 790L: Design in Health Care 2—Design
  - BME 790L: Design in Health Care 3—Deploy
- Required advanced mathematics course and life sciences courses
- Business and management courses
  - BME 590: Quality Management for Biomedical Engineers
  - MENG 540: Management in High-Tech Industries
  - MENG 570: Business Fundamentals
- Required internship
  - MENG 550: Internship
  - MENG 551: Internship Assessment

E-EGR-POS - Master of Engineering in Photonics and Optical Sciences

Program Summary

Title
Master of Engineering in Photonics and Optical Sciences

Degree Designation
ME - Master of Engineering

Type
Primary

Overview
Duke’s Master of Engineering (MEng) in Photonics and Optical Sciences is an alternative to a traditional master of science program that will deepen your understanding of technology and help you develop the business leadership and management expertise you need to succeed in your career. In the Master of Engineering program, you take specialized technical classes and a core of business leadership and management courses, with a required internship or a project completing the degree.

Duke is home to the Fitzpatrick Institute for Photonics (FIP), where researchers are making strides across many areas of photonics and optical science—including making scalable quantum computing a reality, helping doctors do a better job of eradicating cancer, and developing the next generation of high-throughput imaging systems. The research of the FIP faculty is reflected in the courses offered through our Master of Engineering in Photonics and Optical Sciences.
Master of Engineering students train with the very best people in the optics field, and pair that classroom experience with an understanding of core business principles. Our graduates have the technical savvy to move discoveries forward and the business skills to shepherd important advances to realization.

The exceptional resources available through the Fitzpatrick Institute, the Corporate Partnership Program, and the Carolinas Photonics Consortium make Duke a great choice for graduate studies in photonics and optical sciences.

Website: meng.pratt.duke.edu/disciplines/photonics

Requirements

Free Form Requirements
The Master of Engineering in Photonics and Optical Sciences is a 30-credit degree distributed as follows:

- Core Industry Preparation Courses (6 credits)
- Departmental/Disciplinary or Cross-Disciplinary Requirements (15 credits)
- Technical Electives in a Concentration Area (9 credits)
- Internship, Project or Equivalent (0 credits)

Curriculum Notes
1. Students may take 3 units of independent study (BME 899/BME 790 or ECE 899) for a project.
2. Technical elective courses must be selected from Engineering, Physical Sciences, Life Sciences, mathematics or Computer Science unless approved by an advisor.
3. Each student in the P & OS MEng program will be advised on a semester by semester basis to match degree requirements with current course offerings.
4. Graduation requirements include approval of all courses by an advisor.
5. Internship requirements will follow the MEng Internship guidelines with the exception that the internship or project must occur after the student matriculates at Duke University.

Overview

Core Industry Preparation Course Requirements (6 credits)
- MENG 540: Management of High Tech Industries
- MENG 570: Business Fundamentals for Engineers

Departmental/Disciplinary or Cross-Disciplinary Requirements (15 credits)
Required coursework includes:

- Advanced Mathematics Requirement (3 credits required; choose one of the following)
  - MATH 551: Applied Partial Differential Equations and Complex Variables
  - MATH 561: Scientific Computing I
  - MATH 577: Mathematical Modeling
  - PHYSICS 560: Mathematical Methods in Physics

- Required Optics/photonics Courses (6 credits)
  - BME 552/ECE 541/PHY 621: Advanced Optics
  - BME 555: Advances in Photonics

- One technical optics/photonics course from the BME department and one technical optics/photonics course from the ECE department from the following list (6 credits)
  - BME 550: Modern Microscopy
  - BME 590: Biomedical Optical Diagnostics
  - ECE 545: Nanophotonics
  - ECE 546: Optoelectronic Devices
  - ECE 523/PHY 627: Quantum Information Science
  - ECE 573: Optical Communications Systems
  - ECE 590: Laser Systems
E-EGR-RE - Master of Engineering in Risk Engineering

Technical Electives in a Concentration Area (3 courses, 9 credits)
Select three technical courses to satisfy the Technical Electives. Generally, 2 of the 3 should be in similar areas to enable depth in the student's program. Courses may be chosen from the above list or other technical areas, including life sciences, as approved by an advisor. At least one of the technical electives must be an ECE or BME course.

Internship, Project or Equivalent Requirements (0 credits)
- MENG 550: Internship or Applied Research Project
- MENG 551: Internship/Project Assessment

E-EGR-RE - Master of Engineering in Risk Engineering

Program Summary
Title
Master of Engineering in Risk Engineering

Degree Designation
ME - Master of Engineering

Type
Primary

Overview
Mitigating losses and human impacts to a range of extreme events, including financial, public health, environmental, and climatological crises is far more cost-effective than paying for recovery, remediation, and reconstruction.

Duke's Master of Engineering (MEng) in Risk Engineering emphasizes a systems approach and the use of statistical decision theory to assess the potential for extreme events, and the costs and benefits of their consequences.

Our students explore concentration areas including:
- Environment and Public Policy
- Materials and Structures
- Energy and Climate Systems

Website: cee.duke.edu/grad/masters/meng-risk

Requirements
Free Form Requirements
The Master of Engineering in Risk Engineering is a 30-credit degree distributed as:

- Core Industry Preparation Courses (6 credits)
- Core Engineering Courses (6 credits)
- Methodological Requirements (9 credits)
- Technical Electives in a Concentration Area (12 credits)
- Internship, Project or Equivalent (0 credits)

Curriculum and Requirements
- Course Requirements in Business Fundamentals, Leadership and Management (6 credits; 2 courses)
  - MENG 540: Management of High Tech Industries (3 credits)
MENG 570: Business Fundamentals for Engineers (3 credits)

Core Course Requirements in Uncertainty, Risk, and Systems Engineering (6 credits; 2 courses)
- CEE 690: Uncertainty and Risk in Engineering (3 credits)
- EGRMGMT 590: Introduction to Systems Engineering

Methodological Requirements (9 credits; 3 courses, each from a different area of)
- Mathematical Modeling and Optimization
  - CEE 627: Linear Systems Theory
  - CEE 629: System Identification
  - CEE 690: Numerical Optimization
  - PHYS 513: Nonlinear Dynamics
  - MATH 551: Applied Partial Differential Equations and Complex Variables
  - MATH 555: Ordinary Differential Equations
  - MATH 561: Numerical Linear Algebra, Optimization and Monte Carlo Simulation
  - MATH 577: Mathematical Modeling

- Uncertainty Quantification and Data Analytics
  - CEE 644: Inverse Problems in Geosciences and Engineering
  - CEE 690: Uncertainty Quantification
  - ECE 555: Probability for Electrical and Computer Engineers
  - ECE 581: Random Signals and Noise
  - ECE 585: Signal Detection and Extraction Theory
  - COMPSCI 571: Machine Learning
  - COMPSCI 579: Statistical Data Mining
  - MATH 541: Applied Stochastic Processes
  - STA 502: Bayesian Inference & Decision
  - STA 601: Bayesian and Modern Statistics
  - STA 611: Introduction to Modern Statistics
  - STA 623: Statistical Decision Theory

- Valuation, Assessment, and Decision Making
  - CEE 679: Environmental Engineering Project Management
  - ENERGY 590: Applied Energy Economics
  - ECON 753: Natural Resource Economics
  - EMIRON 520/S21: Resource and Environmental Economics
  - EMIRON 638: Environmental Life Cycle Analysis & Decision
  - EMIRON 717: Markets for Electric Power
  - EMIRON 640: Climate Change Economics

- Policy Analysis
  - PUBPOL 504: Counterterrorism Law and Policy
  - PUBPOL 505S: National Security Decision Making
  - PUBPOL 580S: Water Cooperation and Conflict
  - PUBPOL 582: Global Environmental Health: Economics and Policy
  - PUBPOL 583S: Energy and U.S. National Security
  - PUBPOL 585: Climate Change Economics and Policy
  - PUBPOL 607: Cost-Benefit Analysis for Health and Environmental Policy
  - LAW 590: Risk Regulation

- Concentration Area Requirements (9 credits; 3 courses)
  - Environment and Population Health
    - CEE 560: Environmental Transport Phenomena
    - CEE 561: Environmental Aquatic Chemistry
    - CEE 563: Fate and Behavior of Organic Contaminants
    - CEE 571: Control of Hazardous and Toxic Waste
    - CEE 581: Pollutant Transport Systems
    - CEE 667: Chemical Transformations of Environmental Contaminants
    - CEE 683: Groundwater Hydrology and Contaminant Transport
Duke University

- CEE 684: Physical Hydrology and Hydrometeorology
- ENVIRON 539: Human Health & Ecological Risk Assessment
- ENVIRON 563: Cost-Benefit Analysis for Health and Environmental Policy

- **Materials and Structures**
  - CEE 525: Wave Propagation in Elastic and Poroelastic Media
  - CEE 621: Plasticity
  - CEE 642: Environmental Geomechanics
  - CEE 520: Continuum Mechanics
  - CEE 541: Structural Dynamics
  - ME 527: Buckling of Engineering Structures
  - ME 555: Computational Materials Science
  - ME 742: Nonlinear Mechanical Vibration
  - BME 590: Viscoelastic Biomechanics

- **Energy and Climate Systems**
  - CEE 575: Air Pollution Control Engineering
  - ENERGY 716: Modeling for Energy Systems
  - ENERGY 711: Energy and the Environment
  - ENERGY 630: Transportation and Energy
  - ENERGY 631: Energy Technology and Impact on the Environment
  - ENERGY 635: Energy Economics and Policy
  - EOS 512: Climate Change and Climate Modeling

- **An internship, applied research experience, or project (0 credits)**
  - MENG 550: Internship or Applied Research Project
  - MENG 551: Internship/Project Assessment
E-MEDDEV-C - Medical Device Design Certificate

Program Summary

Title
Medical Device Design Certificate

Degree Designation
CER - Certificate

Type
Certificate

Overview
The Department of Biomedical Engineering offers a certificate in Medical Device Design. Through this certificate, BME master's students will gain engineering skills relevant to device design, including electrical, software, and mechanical aspects. This program will explore the device development process, including design ethnography, regulatory controls, manufacturing strategies, and verification and validation testing. Students in this program can expect to be well-prepared for a career in the medical equipment industry. This certificate program is available to students enrolled in Duke’s master’s degree programs in Biomedical Engineering:

- Master of Science (MS), or
- Master of Engineering (MEng)

Students typically apply for the MedTech graduate certificate during their first semester at Duke. The certificate is completed during the second and third semesters.

Website: bme.duke.edu/masters/degrees/medtech-design

Requirements
Free Form Requirements
The four (4) MedTech courses that fulfill this graduate certificate provide for 12 of the 30 course credits required for a Duke master's degree in biomedical engineering. The courses are:

- Advanced Design and Manufacturing, or Medical Electrical Equipment
- Design in Health Care 1, or Design in Health Care 3
- Design in Health Care 2
- Quality Management Systems

E-MGT-DME - Master of Engineering Management—Online

Program Summary

Title
Master of Engineering Management—Online

Degree Designation
MEG - Master of Engineering Management

Type
Primary

Overview
The Pratt School of Engineering at Duke University offers an interdisciplinary Master of Engineering Management (MEM) degree in cooperation with The Fuqua School of Business and the Duke University School of Law. Designed to develop engineering leaders of consequence for technology-based organizations, the degree provides a personalized, applied engineering management curriculum to a select group of high-potential students with science and engineering backgrounds.

Duke’s MEM Program was launched in 1997 out of recognition that society needs engineers with business skills. This is consistent with current interest to develop “T-shaped” individuals with focused expertise in a technical area of interest (the stem of the T) and breadth of workplace skills, such as business acumen and leadership (the top of the T). To address complex societal grand challenges, it is imperative that engineers have the interdisciplinary perspective to understand not only technological challenges, but also the environmental, societal, and fiscal implications of engineering design decisions.

Duke offers an online education program for working professionals, known as the MEM Online Program. This program combines three week-long residencies with semester-based online coursework that allows students to work and attend school simultaneously. The online courses are accessible via the web and allow a student to participate synchronously or asynchronously according to their needs.
Duke University

and schedule. In addition to the course content, these integrated courses allow students to learn effective skills for working productively with others from a distance.

In summary, Duke’s interdisciplinary Master of Engineering Management Program produces leaders of consequence—graduates with “T-shaped” skill sets encompassing a solid business foundation and focused technical expertise. Perhaps more importantly, they have developed the ability to think critically and creatively, enabling them to use that expertise to make a profound impact on society.

The core of the Master of Engineering Management Program consists of four engineering management courses developed in conjunction with the Duke University School of Law and The Fuqua School of Business. A required internship accompanied by a written project summary and oral presentation insures students have work experience, while four graduate-level technical courses of the student’s choosing serve to extend the student’s science and engineering background.

Website: memp.pratt.duke.edu/online

Requirements

Free Form Requirements
To complete a master’s degree in engineering management, the student must complete 30.0 course credits:

- Four core management courses (12.0 credits)
  - Engineering Management 510 (Marketing)
  - Engineering Management 520 (Intellectual Property, Business Law, and Entrepreneurship)
  - Engineering Management 530 (Finance in High-Tech Industries)
  - Engineering Management 540 (Management of High-Tech Industries)
- Four technical elective courses (12.0 course credits)
- Three one-week residencies (0 course credits)
- Internship, written project summary, oral presentation (6.0 course credits)
  - Engineering Management 550 (Engineering Management Internship)
  - Engineering Management 551 (Engineering Management Internship Assessment)

Internship

The internship component of Duke’s MEM Program ensures that students gain valuable experience in industry. Students complete an internship with a company anywhere in the world and work on a well-defined project (Engineering Management 550). A minimum of eight weeks of full-time work, or 320 hours, must be completed to satisfy the internship experience requirements. A final internship report and presentation must be submitted and both must be approved by the course instructor before credit can be given (Engineering Management 551). Internship contributes 6 course credits toward graduation.

Students are responsible for finding and establishing an internship, though there are several resources that can help in the search. Students who are still enrolled in undergraduate study are encouraged to use their institution’s career center, and previously employed students should use their experience. Students with previous work experience may apply that work experience to the internship requirements, as long as the work they performed was in the field of engineering and can satisfy the internship assessment course requirements. MEM Online students will utilize their current employment to meet the internship requirements.

Residencies

MEM Online students also complete three weeklong residencies at Duke—and have the option of attending classes in-person at Duke at any time.

The opportunities to interact with Duke Engineering Management students in our campus program include physical class attendance, project collaboration, and class assignment partnering through teleconferencing, student forums and other media alternatives.

Technical Electives

Technical electives enable students to customize coursework to satisfy their individual preferences. Elective offerings are designed to provide variety, flexibility, and top-of-class quality as students enhance their depth and breadth of knowledge. Courses below the graduate level, typically below the 500 level, may not be applied toward the required technical electives for the master of engineering
management degree. Students may enroll in courses below the graduate level, but these courses will not count toward any graduation requirement and will not be included in a student’s GPA calculation.

Students may utilize the following options:

- select from a variety of topics in the area of management of technology and entrepreneurship offered by the MEM Program;
- take courses at the highly-ranked departments within the Pratt School of Engineering, including the top-ranked biomedical engineering department;
- customize an interdisciplinary set of courses in subjects such as photonics or nanotechnology;
- take courses outside of the Pratt School of Engineering with the director’s approval from The Fuqua School of Business (Enrollment in Fuqua courses is not guaranteed; rather, Fuqua courses are offered on a space available basis and require instructor consent. Additionally, not all Fuqua courses are available to MEM students and not all of those that are offered can be used as a technical elective. MEM students are limited to two Fuqua courses per semester. Fuqua courses require a separate registration process than that of engineering courses.);
- take courses in areas such as physics, chemistry, computer science, or statistics/decision science;
- pursue courses at North Carolina State University and the University of North Carolina at Chapel Hill through an interinstitutional transfer and with approval of the director;
- develop an independent study course by identifying a topic and an interested faculty member. Students may take up to two independent study courses; or
- take other technical electives as approved.

Example curricula for online students are available on the Master of Engineering Management website at memp.pratt.duke.edu/online/curriculum.

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### Duke University

**E-MGT-MEG - Master of Engineering Management**

#### Program Summary

**Title**
Master of Engineering Management

**Degree Designation**
MEG - Master of Engineering Management

**Type**
Primary

**Overview**

The Pratt School of Engineering at Duke University offers an interdisciplinary Master of Engineering Management (MEM) degree in cooperation with The Fuqua School of Business and the Duke University School of Law. Designed to develop engineering leaders of consequence for technology-based organizations, the degree provides a personalized, applied engineering management curriculum to a select group of high-potential students with science and engineering backgrounds.

Duke’s MEM Program was launched in 1997 out of recognition that society needs engineers with business skills. This is consistent with current interest to develop “T-shaped” individuals with focused expertise in a technical area of interest (the stem of the T) and breadth of workplace skills, such as business acumen and leadership (the top of the T). To address complex societal grand challenges, it is imperative that engineers have the interdisciplinary perspective to understand not only technological challenges, but also the environmental, societal, and fiscal implications of engineering design decisions.

In summary, Duke’s interdisciplinary Master of Engineering Management Program produces leaders of consequence—graduates with “T-shaped” skill sets encompassing a solid business foundation and focused technical expertise. Perhaps more importantly, they have developed the ability to think critically and creatively, enabling them to use that expertise to make a profound impact on society.

The core of the Master of Engineering Management Program consists of four engineering management courses developed in conjunction with the Duke University School of Law and The Fuqua School of Business. A required internship accompanied by a written project summary and oral presentation insures students have work experience, while four graduate-level technical courses of the student’s choosing serve to extend the student’s science and engineering background.

**Website:** memp.pratt.duke.edu/campus

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### Requirements
Free Form Requirements

To complete a master’s degree in engineering management, the student must complete 30.0 course credits:

- Four core management courses (12.0 credits)
  - Engineering Management 510 (Marketing)
  - Engineering Management 520 (Intellectual Property, Business Law, and Entrepreneurship)
  - Engineering Management 530 (Finance in High-Tech Industries)
  - Engineering Management 540 (Management of High-Tech Industries)
- Four technical elective courses (12.0 course credits)
- Seminar & Workshop Series (0 course credits)
  - Engineering Management 501 (Engineering Management Seminar/Workshop) (require two semesters)
- Internship, written project summary, oral presentation (6.0 course credits)
  - Engineering Management 550 (Engineering Management Internship)
  - Engineering Management 551 (Engineering Management Internship Assessment)

Internship

The internship component of Duke’s MEM Program ensures that students gain valuable experience in industry. Students complete an internship with a company anywhere in the world and work on a well-defined project (Engineering Management 550). A minimum of eight weeks of full-time work, or 320 hours, must be completed to satisfy the internship experience requirements. A final internship report and presentation must be submitted and both must be approved by the course instructor before credit can be given (Engineering Management 551). Internship contributes 6 course credits toward graduation.

Students are responsible for finding and establishing an internship, though there are several resources that can help in the search. Students who are still enrolled in undergraduate study are encouraged to use their institution’s career center, and previously employed students should use their experience. Students with previous work experience may apply that work experience to the internship requirements, as long as the work they performed was in the field of engineering and can satisfy the internship assessment course requirements.

Seminar and Workshop Series

Weekly seminars offer campus students the opportunity to interact with top industry leaders, experienced managers, entrepreneurs, venture capitalists, and small-business owners. Designed to introduce students to different aspects of industry, the series also includes information on career opportunity and development.

Duke’s unique workshop series allows students to further develop marketable skills in an intensive, interactive environment. Topics are selected through input from industry, program administrators, and students and led by the professional development coordinator.

Technical Electives

Technical electives enable students to customize coursework to satisfy their individual preferences. Elective offerings are designed to provide variety, flexibility, and top-of-class quality as students enhance their depth and breadth of knowledge. Courses below the graduate level, typically below the 500 level, may not be applied toward the required technical electives for the master of engineering management degree. Students may enroll in courses below the graduate level, but these courses will not count toward any graduation requirement and will not be included in a student’s GPA calculation.

Students may utilize the following options:

- select from a variety of topics in the area of management of technology and entrepreneurship offered by the MEM Program;
- take courses at the highly-ranked departments within the Pratt School of Engineering, including the top-ranked biomedical engineering department;
- customize an interdisciplinary set of courses in subjects such as photonics or nanotechnology;
- take courses outside of the Pratt School of Engineering with the director’s approval from The Fuqua School of Business (Enrollment in Fuqua courses is not guaranteed; rather, Fuqua courses are offered on a space available basis and require instructor consent. Additionally, not all Fuqua courses are available to MEM students and not all of those that are offered can be used as a technical elective. MEM students are limited to two Fuqua courses per semester. Fuqua courses require a separate registration process than that of engineering courses.);
- take courses in areas such as physics, chemistry, computer science, or statistics/decision science;
- pursue courses at North Carolina State University and the University of North Carolina at Chapel Hill through an interinstitutional
An example curriculum for on-campus students is available on the Master of Engineering Management website at memp.pratt.duke.edu/campus/curriculum.

**E-NEURAL-C - Neural Engineering Certificate**

**Program Summary**

**Title**
Neural Engineering Certificate

**Degree Designation**
CER - Certificate

**Type**
Certificate

**Overview**

The Department of Biomedical Engineering offers a certificate in Neural Engineering. Focusing on the importance of identifying and treating nervous system disorders and diseases, this certificate introduces students to the analytical and practical skills necessary in the field of neural engineering. Students who complete the Neural Engineering certificate are well-positioned to become research engineers, development engineers in the medical device industry, or successful candidates in doctoral programs. This certificate is open to students in the BME Master of Engineering (MEng), Master of Science (MS), and PhD programs, and the Medical Technology Design Master of Engineering program.

**Website:** bme.duke.edu/masters/certificates/neural-engineering

**Requirements**

**Free Form Requirements**

To earn this certificate, students complete the standard 30-credit master’s curriculum, but with these neural-engineering course options:

- **Life Science Course requirement:**
  - Quantitative Pathophysiology, or
  - Physiology for Engineers

- **BME Courses requirement:**
  - BME 601L Introduction to Neural Engineering, and
  - Three (3) Neural Engineering electives
K-EGR-ECE - Master of Engineering in Electrical and Computer Engineering (Duke Kunshan University)

Program Summary

Title
Master of Engineering in Electrical and Computer Engineering (Duke Kunshan University)

Degree Designation
ME - Master of Engineering

Type
Primary

Overview

Duke Kunshan University (DKU) is a partnership of Duke University and Wuhan University to create a world-class university offering a range of academic programs and conferences for students from China and throughout the world. Duke Kunshan University is located in Kunshan, Jiangsu province, China. Located in close proximity to both Shanghai and Suzhou, and connected to both by high-speed rail, the city of Kunshan is a center for business and high-tech research and manufacturing, and has one of the fastest growing economies in China.

Duke Kunshan University Master of Engineering (MEng) in Electrical and Computer Engineering

This two-year master’s degree program is built upon Duke’s Master of Engineering Program in electrical and computer engineering. This program was designed with Chinese industrial needs in mind—exposing students to US-style education as well as modern Chinese industry practices and industry standards. Seeking to develop tech leaders with a global perspective, the program affords students the opportunity to learn business and industrial management fundamentals, as well as core engineering skills. The curriculum as a whole is designed to develop engineers who have the knowledge, leadership skills, and creative problem-solving abilities necessary to thrive in the global tech sector.

Students enrolled in the two-year program will spend their first year at Duke Kunshan University and their second year at Duke in the Pratt School of Engineering. Upon graduation, students will receive a Duke Master of Engineering degree and become alumni of both Duke University and Duke Kunshan University.

Website: iapse.dukekunshan.edu.cn/about-ece

Requirements

Free Form Requirements

Duke Kunshan University MEng students must complete 30.0 course credits composed of key program elements as follows:

- Two core industry preparatory courses (6.0 course credits)
  - Management of High Tech Industries
  - Business Fundamentals for Engineers
- Three core Electrical and Computer Engineering (ECE) concentration electives (9.0 course credits)
  - Concentration areas: Software development or big data analysis
- Two graduate technical electives (6.0 course credits)
- Three approved electives (9.0 course credits)
- Language and professional training courses (0 course credits)
- Summer Internship (0 course credits)

Core Industry Preparatory Courses

The core industry preparatory courses provide students with the skills they need to succeed in industry. Business savvy and technical expertise gained in the Duke Kunshan University MEng Program will help students understand and work effectively in a corporate climate.

All Courses
### AIPI501 - AIPI Seminar

**Subject** | **Catalog Number** | **Title**  
---|---|---  
AIPI | 501 | AIPI Seminar  

**Description**
Current topics in AI for Product Innovation. Seminars provide students opportunities to learn from industry leaders. Weekly sessions foster community and the development of a peer network within the cohort.

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### AIPI502 - AIPI Workshops

**Subject** | **Catalog Number** | **Title**  
---|---|---  
AIPI | 502 | AIPI Workshops  

**Description**
Workshops provide opportunities to develop and improve professional skills. Selected topics support student success within industry roles.

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### AIPI503 - Python Bootcamp

**Subject** | **Catalog Number** | **Title**  
---|---|---  
AIPI | 503 | Python Bootcamp  

**Description**
Introductory Python programming and probability and statistics bootcamp to prepare students for Fall programming courses. Students who already have proficiency in Python will have opportunities to test out of portions of the boot camp.

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### AIPI504 - Introductory Residency

**Subject** | **Catalog Number** | **Title**  
---|---|---  
AIPI | 504 | Introductory Residency  

**Description**
One week course to introduce the Master of Engineering in AI for Product Innovation Online Program. Residency 1 includes an orientation to Duke and the program, case studies, professional development workshops and alumni engagement opportunities. Prerequisite: Enrollment in the Master of Engineering in AI for Product Innovation Online Program.

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### AIPI505 - Mid-Program Residency

**Subject** | **Catalog Number** | **Title**  
---|---|---  
AIPI | 505 | Mid-Program Residency  

**Description**
One week course to assess interim progress for the Master of Engineering in AI for Product Innovation Online Program. Residency 2 includes team-building exercises, case studies, workshops, seminars and engagement opportunities. Prerequisite: Enrollment in the Master of Engineering in AI for Product Innovation Online Program, AIPI504.

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### AIPI510 - Sourcing Data for Analytics
Duke University

AIPI520 - Modeling Process and Algorithms

Subject
AIPI
Catalog Number
520
Title
Modeling Process and Algorithms

Description
This course is an introduction to the modeling process and best practices in model creation, interpretation, validation, and selection of models for different uses. The primary machine learning algorithms, both supervised and unsupervised, are introduced and explained with the necessary level of mathematical theory to establish students’ intuition for how each algorithm works. At the end of this course, students should have a solid understanding of the end-to-end modeling process and the different types of model algorithms along with the strengths, weaknesses, assumptions, and use cases for each type.

AIPI530 - Optimization in Practice

Subject
AIPI
Catalog Number
530
Title
Optimization in Practice

Description
Optimization is the ultimate skill in artificial intelligence and prescriptive analytics allowing practitioners to generate the best actionable solutions for business needs. This class will give students required skills to mathematically formulate relevant business problems as optimization models, use leading software modeling syntax and solvers to generate optimum solutions and meaningfully interpret these solutions. We will use both SAS/Optmodel and Python/Pyomo to give student experience with proprietary and open-source optimization software. Focus will be on problem formulation and results interpretation.

AIPI531 - Deep Reinforcement Learning Applications

Subject
AIPI
Catalog Number
531
Title
Deep Reinforcement Learning Applications

Description
Deep Reinforcement Learning Appl. will cover advanced sequential decision-making topics in AI and will consist of two parts 1) deep reinforce. learning theory and 2) deep reinforce. learning applications. Deep reinforce. learning combines reinforce. learning and deep learning. The theory module will introduce students to major deep reinforce. learning algorithms, modeling process, and programming. The applications module will include case studies on the practical applications of deep reinforce. learning in industry. This is a project-based course with extensive Pytorch/Tensorflow hands-on exercises. Students will also have an opportunity to improve their GitHub profile by working on projects.

AIPI540 - Deep Learning Applications
AIPI549 - Capstone Practicum 1

Subject: AIPI
Catalog Number: 549
Title: Capstone Practicum 1

Description:
First of two courses comprising the AIPI capstone practicum project experience. Students will work in teams on a real-world AI-related project for an industry sponsor. Students will conduct the end-to-end research, definition, design, prototyping and evaluation of an AI model integrated into a new or existing product or system. Prerequisites: Enrollment in the Master of Engineering in AI for Product Innovation Program, AIPI 510, 520, 530.

AIPI560 - Legal, Societal, and Ethical Implications of AI

Subject: AIPI
Catalog Number: 560
Title: Legal, Societal, and Ethical Implications of AI

Description:
Deploying AI within products and services has implications well beyond the technical considerations, which often include change management of operational workflows or staffing levels, data privacy considerations, bias risks and other ethical implications, and industry-specific regulations on the use of data and models operationally. This course will introduce students to the key areas of consideration when deploying products which contain AI: 1) legal implications and industry regulation, 2) ethical considerations, and 3) change management and organizational/societal implications. Case studies will be used extensively to provide real-world examples.

AIPI561 - Operationalizing AI

Subject: AIPI
Catalog Number: 561
Title: Operationalizing AI

Description:
Deploying AI in production requires consideration of factors such as online model training, scaling, integration with software/hardware products, monitoring/support, security and failure resiliency. This course introduces students via readings and real-world case studies to methods and best practices in deploying AI operationally within products and services, including both technology and support infrastructure considerations. The course will also introduce, although not go into deep technical detail on, the available technologies for working with Big Data in certain industries which require specialized infrastructure and tools due to the volume of data.

AIPI590 - Advanced Topics in AI for Products Innovation
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<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
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<tbody>
<tr>
<td>AIPI</td>
<td>590</td>
<td>Advanced Topics in AI for Products Innovation</td>
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<tr>
<td>AIPI</td>
<td>590L</td>
<td>Advanced Topics in AI for Products Innovation (with Lab)</td>
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<tr>
<td>AIPI</td>
<td>591</td>
<td>Special Readings in AI for Product Innovation</td>
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<tr>
<td>BME</td>
<td>503</td>
<td>Computational Neuroengineering (GE, EL)</td>
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<tr>
<td>BME</td>
<td>504</td>
<td>Fundamentals of Electrical Stimulation of the Nervous System (EL, GE)</td>
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</tbody>
</table>

**Description**

- **AIPI590L - Advanced Topics in AI for Products Innovation (with Lab)**
  - Opportunity for study of advanced subjects with laboratory related to programs within AI for Product Innovation tailored to fit the requirements of a small group. Permission of instructor required.

- **AIPI591 - Special Readings in AI for Product Innovation**
  - Individual readings in advanced study and research areas of AI for Product Innovation. Prerequisite: Enrollment in the Master of Engineering in AI for Product Innovation Program. Consent of instructor required.

- **BME503 - Computational Neuroengineering (GE, EL)**
  - This course introduces students to the fundamentals of computational modeling of neurons and neuronal circuits and the decoding of information from populations of spike trains. Topics include: integrate and fire neurons, spike response models, homogeneous and inhomogeneous Poisson processes, neural circuits, Weiner (optimal) adaptive filters, neural networks for classification, population vector coding and decoding. Programming assignments and projects will be carried out using MATLAB. Prerequisites: Biomedical Engineering 301L or equivalent.

- **BME504 - Fundamentals of Electrical Stimulation of the Nervous System (EL, GE)**
  - This course presents a quantitative approach to the fundamental principles, mechanisms, and techniques of electrical stimulation required for non-damaging and effective application of electrical stimulation. Consent of instructor required. Prerequisite: BME 301L or graduate standing. (EL, GE)
**BME505L - Biopotential Amplifiers and Implant Devices (GE, EL, IM)**

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<th>Subject</th>
<th>Catalog Number</th>
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<tbody>
<tr>
<td>BME</td>
<td>505L</td>
<td>Biopotential Amplifiers and Implant Devices (GE, EL, IM)</td>
</tr>
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</table>

**Description**

This course will cover fundamental principles and circuits for implantable medical devices, geared to advanced undergraduates and graduate students interested in understanding the basics of hardware design for implantable neurological devices. Specific circuit examples of low-power amplifiers and implantable devices will be discussed. A system level approach that optimizes performance, reliability and power consumption will be emphasized. In parallel, printed circuit board design and fabrication will be presented. Principles of bioinstrumentation will be reinforced through practical design exercises. Prerequisite: BME 301L or graduate standing. (EL, IM, GE).

**BME506 - Measurement and Control of Cardiac Electrical Events (GE, EL, IM)**

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<th>Subject</th>
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<th>Title</th>
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<tr>
<td>BME</td>
<td>506</td>
<td>Measurement and Control of Cardiac Electrical Events (GE, EL, IM)</td>
</tr>
</tbody>
</table>

**Description**

Design of biomedical devices for cardiac application based on a review of theoretical and experimental results from cardiac electrophysiology. Evaluation of the underlying cardiac events using computer simulations. Examination of electrodes, amplifiers, pacemakers, and related computer apparatus. Construction of selected examples. Prerequisites: Biomedical Engineering 301L; 354L or instructor consent.

**BME507 - Cardiovascular System Engineering, Disease and Therapy (GE, BB, EL)**

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<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
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<tbody>
<tr>
<td>BME</td>
<td>507</td>
<td>Cardiovascular System Engineering, Disease and Therapy (GE, BB, EL)</td>
</tr>
</tbody>
</table>

**Description**

Introductory and advanced topics in anatomy, physiology, pathophysiology, and modeling of the cardiovascular system. Theoretical and bioengineering concepts of heart electrical and mechanical function and circulatory system at cellular, tissue, and organ level. Computational models of cardiac electrical and mechanical activity and pressures and volumes within circulatory system. Contemporary cell, gene, and device-based therapies for treatment of cardiac and cardiovascular disease. The course enhances students’ knowledge of cardiovascular system function with the emphasis of underlying engineering principles. Prerequisites: two of Biomedical Engineering 301L, 302L, 307 or graduate standing in BME.

**BME510 - Bayesian Analysis in Biomedical Engineering (GE, EL)**

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<tr>
<td>BME</td>
<td>510</td>
<td>Bayesian Analysis in Biomedical Engineering (GE, EL)</td>
</tr>
</tbody>
</table>

**Description**

The application of Bayesian statistics to questions in BME broadly with a focus on electrocardiography. Topics include a brief history of Bayesian math in biology and medicine, use of likelihood functions and prior distributions, the Bayesian outlook toward medical diagnosis, the work of Cornfield, Pipberger, and Dunn on the classification of electrocardiograms, and a Bayesian framework for the cardiac inverse problem. The approaches used for these topics can be adapted to many other BME situations. Prerequisites: Senior or graduate standing.
BME512L - Cardiac Bioelectricity (GE, EL)

Subject: BME
Catalog Number: 512L
Title: Cardiac Bioelectricity (GE, EL)

Description:
Electrophysiological behavior of cardiac muscle. Emphasis on quantitative study of cardiac tissue with respect to propagation and the evaluation of sources. Effect of junctions, inhomogeneities, anisotropy, and presence of unbounded extracellular space. Bidomain models. Study of models of arrhythmia, fibrillation, and defibrillation. Electrocardiographic models and forward simulations. Laboratory exercises based on computer simulation, with emphasis on quantitative behavior and design. Readings from original literature.
Prerequisite: Biomedical Engineering 301L or equivalent.

BME513 - Introduction to Neurodynamics (EL, GE)

Subject: BME
Catalog Number: 513
Title: Introduction to Neurodynamics (EL, GE)

Description:
Behavior of neurons and neuronal networks examined with methods of nonlinear dynamics. Interpretation in phase space of excitability, spiking, bursting, phase locking, synchronization, competition, and chaos. Applications to the development of novel neurostimulation methods and to understanding dynamic mechanisms behind sensing, learning, memory, and cognition. Readings from the original literature. Prerequisites BME 301L, graduate standing or consent of instructor. (EL, GE)

BME515 - Neural Prosthetic Systems (GE, EL, IM)

Subject: BME
Catalog Number: 515
Title: Neural Prosthetic Systems (GE, EL, IM)

Description:
Covers several systems that use electrical stimulation or recording of the nervous system to restore function following disease or injury. For each system, the underlying biophysical basis for the treatment, the technology underlying the treatment, and the associated clinical applications and challenges are examined. Systems to be covered include cochlear implants, spinal cord stimulation of pain, vagus nerve stimulation for epilepsy, deep brain stimulation for movement disorders, sacral root stimulation for bladder dysfunction, and neuromuscular electrical stimulation for restoration of movement. Prerequisite: BME 301L or ECE 110L.

BME517 - Neuronal Control of Movement (GE, EL)

Subject: BME
Catalog Number: 517
Title: Neuronal Control of Movement (GE, EL)

Description:
Course for graduate and upper-level undergraduate students to provide them with an understanding of the neuronal circuits that move our bodies and with techniques for analysis, simulation, and modification of these circuits by neural engineers. Topics start in the periphery with muscles, the spine, and functional electrical stimulation; then proceed centrally to subcortical circuits, deep brain stimulation, and forward models; and conclude with cerebral cortical networks and population decoding. Students are expected to have background in bioelectricity and Matlab programming. Prerequisites: BME 301L or consent of the instructor.

BME518L - Modern Neuroscience Tools (GE, IM, EL)
### BME520L - Computational Foundations of Biomedical Simulation (GE, BB, MC)

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<th>Subject</th>
<th>Catalog Number</th>
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<tbody>
<tr>
<td>BME</td>
<td>520L</td>
<td>Computational Foundations of Biomedical Simulation (GE, BB, MC)</td>
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</table>

**Description**
This is an applications course highlighting the use of parallel simulation in solving biomedical problems. The goal is to provide a foundation in the tools and methods for building and implementing applications for parallel architectures including source-code control and testing frameworks. Topics will include computational abstraction, performance profiling and analysis, scalability, thread- and core-level parallelism, I/O, and visualization. Prerequisites: BME 302L or BME 307 or graduate standing.

### BME524 - Nanotechnology in Medicine (GE, BB, MC)

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<th>Subject</th>
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<tr>
<td>BME</td>
<td>524</td>
<td>Nanotechnology in Medicine (GE, BB, MC)</td>
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</table>

**Description**
Nanomedicine impacts biomedical sciences by applying nanotechnology to develop devices with nanoscale features for applications in therapeutics, diagnostics, and molecular tools. The course covers the application of nanotechnology to advance drug therapy, gene therapy, immunotherapy, and cell therapy and discusses engineering design and fabrication strategies for practical implementation. Most recent advances in the field will be discussed. Student's critical understanding will be evaluated through written or oral presentations. Prerequisite: BME 302L or BME 307 or permission of the instructor.

### BME526 - Elasticity (GE, BB)

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<tr>
<td>BME</td>
<td>526</td>
<td>Elasticity (GE, BB)</td>
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</table>

**Description**
Linear elasticity will be emphasized including concepts of stress and strain as second order tensors, equilibrium at the boundary and within the body, and compatibility of strains. Generalized solutions to two and three dimensional problems will be derived and applied to classical problems including torsion of noncircular sections, bending of curved beams, stress concentrations and contact problems. Applications of elasticity solutions to contemporary problem in civil and biomedical engineering will be discussed. Prerequisites: Engineering 201L; Mathematics 353.

### BME527 - Cell Mechanics and Mechanotransduction (GE, BB, MC)
BME527 - Cell Mechanics and Mechanotransduction (GE, BB, MC)

Description
An examination of the mechanical properties of cells and forces exerted by cells in biological processes of clinical and technological importance, and the processes by which mechanical forces are converted into biochemical signals and activate gene expression. Topics include measurement of mechanical properties of cells, cytoskeleton mechanics, models of cell mechanical properties, cell adhesion, effects of physical forces on cell function, and mechanotransduction. Students critically evaluate current literature and analyze models of cell mechanics and mechanotransduction. Prerequisites: BME 302L or BME 307; knowledge of cell biology.

BME528 - Biofluid Mechanics (GE, BB, MC)

Description
Methods and applications of fluid mechanics in biological and biomedical systems including: Governing equations and methods of solutions, (e.g. conservation of mass flow and momentum), the nature of biological fluids, (e.g. non Newtonian rheological behavior), basic problems with broad relevance, (e.g. flow in pipes, lubrication theory), applications to cells and organs in different physiological systems, (e.g. cardiovascular, gastrointestinal, respiratory, reproductive and musculoskeletal systems), applications to diagnosis and therapy, (e.g. drug delivery and devices). Prerequisite: Biomedical Engineering 307 or graduate student standing.

BME529 - Theoretical and Applied Polymer Science (GE, BB)

Description
An intermediate course in soft condensed matter physics dealing with the structure and properties of polymers and biopolymers. Introduction to polymer syntheses based on chemical reaction kinetics, polymer characterization. Emphasizes (bio)polymers on surfaces and interfaces in aqueous environments, interactions of (bio)polymer surfaces, including wetting and adhesion phenomena.

BME530 - Introduction to Tissue Biomechanics (GE, BB)

Description
Introduction to the mechanical behaviors of biological tissues, cells and molecules of the musculoskeletal and cardiovascular systems. Topics to be covered include static force analysis and nonlinear optimization theory; linearly elastic models for stress-strain analysis and solutions to relevant problems in bioelasticity; models of active structures (e.g., muscles); and introductory theory for finite element analysis. Emphasis will be placed on modeling stress-strain relations with relevance to biological tissues, including experimental means to measure stress and strain in these structures. Prerequisites: Engineering 201 or equivalent; Biomedical Engineering 302 or equivalent; Mathematics 353.

BME531 - Intermediate Biomechanics (GE, BB)
BME535 - Biomedical Aspects of Blast and Ballistics (GE, BB)

Description
Introduction to the biomechanical basis and medical consequences of human injury from blast and ballistics. Exploration of blast and ballistics injuries in both biomechanics and medicine covering the etiology and state-of-the-art analytic and biomechanical models of human injury. Evolution of medical opinion compared to contemporary knowledge of ballistics and blast. Focus on injuries to the head, neck, thorax, abdomen and extremities, and associated medical consequences, including shock, immune system response, traumatic brain injury (TBI) and posttraumatic stress disorder (PTSD). Prerequisite: Biomedical Engineering 302L, graduate standing, or consent of instructor.

BME542 - Principles of Ultrasound Imaging (GE, IM)

Description
Propagation, reflection, refraction, and diffraction of acoustic waves in biologic media. Topics include geometric optics, physical optics, attenuation, and image quality parameters such as signal-to-noise ratio, dynamic range, and resolution. Emphasis is placed on the design and analysis of medical ultrasound imaging systems. Prerequisites: Biomedical Engineering 303; Engineering 103L; or instructor consent.

BME543L - Cardiac Ultrasound Imaging and Function (GE, IM)

Description
Course combines medical instrumentation with a contrasting engineering and clinical perspective, with a focus on ultrasound cardiac imaging and measurement. The classroom aspect covers the physical basis of ultrasound cardiac imaging and measurements. The clinical component consists of cardiac anatomy and physiology, case studies, and clinical observations. The course includes two cardiac dissections and a hands-on experience in the Human Anatomy Lab. Students are required to develop image analysis software from supplied clinical 3D images to automatically determine quantitative physical descriptors of cardiac function. Prerequisite: Biomedical Engineering 354L or instructor consent. Instructor consent required.

BME544 - Digital Image Processing (GE, IM)
BME544 - Digital Image Processing (GE, IM)

**Description**
Introduction to the theory and methods for digital image sampling, enhancement, visualization, reconstruction, and analysis with emphasis on medical applications. Course Outline: #1: Introduction, history, and applications of image processing. #2: Spatial domain image enhancement. #3: Fourier domain image enhancement. #4: Image registration. #5: Inverse problems (denoising, deblurring, interpolation, and super-resolution). #6: Wavelets and compressive sensing. #7: Biological image processing. Undergraduate courses on signals and systems, probability and statistics recommended; knowledge of Matlab required. Prerequisites: Biomedical Engineering 271 or Electrical and Computer Engineering 280L or consent of the instructor. Instructor consent required.

BME546 - Magnetic Resonance Imaging: Physical Principles and Sequence Design (GE, IM)

**Description**
An in-depth exploration of the physics and engineering in developing Magnetic Resonance Imaging (MRI). Topics covered include Gradient Recalled Echo, Spin Echo, Inversion Recovery, field of view and resolution constraints/requirements, signal processing, image artifacts, the Bloch Equation, fat suppression techniques, and the derivation of MR signal equation. Prerequisite: Biomedical Engineering 303 or consent of instructor.

BME547 - Medical Software Design (GE, IM)

**Description**
Software is critical in many medical devices, including device control, feedback and signal processing. This course focuses on software development skills that are ubiquitous in the medical device industry, including software version control, unit testing, fault tolerance, continuous integration testing and documentation. Experience will be gained in Python and JavaScript. The course will be structured around a project, done in small student groups, to build an Internet-connected medical device that measures and processes a biosignal, sends it to a web server, and makes those data accessible to a web client/mobile application. Prerequisite: Biomedical Engineering 271, Biomedical Engineering 271A, or graduate student standing.

BME548L - Machine Learning and Imaging (GE, IM)

**Description**
Deep learning is rapidly changing how we interpret image data. A large amount of research is now examining how we can use new machine learning tools to automatically interpret microscope, ultrasound and x-ray images, and MRI and CT scans, for example, to aid with diagnostic tasks. In this class, we will review how these machine learning tools work, with a particular focus on how they might be used in a diagnostic setting. This class will also investigate the specific question of how deep learning algorithms can be used to design imaging system hardware to improve performance, which will be the primary focus of the course final project. Prerequisite: BME 303L or graduate standing.
### BME550 - Modern Microscopy (GE, IM)

**Subject**  
BME  

**Catalog Number**  
550  

**Title**  
Modern Microscopy (GE, IM)  

**Description**  
Overview of novel microscopy techniques that are under development in research laboratories. New techniques are placed in context with basic understanding of image formation in conventional microscopy and laboratory work which applies this knowledge. A group project offers opportunity to examine special topics of interest. Prerequisite: Biomedical Engineering 354 and 303; consent of the instructor.

### BME551L - Biomedical Optical Spectroscopy and Tissue Optics (GE, IM)

**Subject**  
BME  

**Catalog Number**  
551L  

**Title**  
Biomedical Optical Spectroscopy and Tissue Optics (GE, IM)  

**Description**  
This course is designed to provide students with a working knowledge of the theoretical and experimental principles underlying the application of optical spectroscopy and tissue optics in biological and biomedical engineering. Topics covered in this course include: Absorption Spectroscopy; Scattering Spectroscopy; Fluorescence Spectroscopy; Tissue Optics; Monte Carlo Modeling; Diffusion Modeling; Spectroscopic System Design and Signal to Noise Analysis; and Molecular Imaging. This course also includes labs for each topic that is covered, journal article review on emerging technologies and a term project. Prerequisite: Physics 152L.

### BME552 - Advanced Optics

**Subject**  
BME  

**Catalog Number**  
552  

**Title**  
Advanced Optics  

**Description**  
This course presents a rigorous treatment of topics in Photonics and Optics targeted at students with an existing photonics or optics background. Topics will include, Optical Sources, Statistical Optics and Coherence Theory, Detection of Radiation; Nonlinear Optics; Waveguides and Optical Fibers; Modern Optical Modulators; Ultrafast lasers and Applications. These topics will be considered individually and then from a system level perspective. Prerequisite: Electrical and Computer Engineering 340L or equivalent.

### BME555 - Advances in Photonics (GE, IM)

**Subject**  
BME  

**Catalog Number**  
555  

**Title**  
Advances in Photonics (GE, IM)  

**Description**  
Overview of photonics techniques and their applications. The course will enhance students’ understanding and knowledge of advanced techniques and introduce them to a variety of applications in photonics, the science and technology associated with interactions of light with matter. Photonics techniques include: advanced luminescence, Raman and SERS, optical coherence, advanced microscopy, near-field and confocal methods, remote sensing, and optical biosensing. Applications include: environmental sensing, medical diagnostics, assays using optical detection, optics in multispectral imaging, photonics and solar cells, and nanophotonics. Prerequisite: senior or graduate standing in BME or Chemistry.

### BME561L - Genome Science and Technology Lab (GE, MC)
### Duke University

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<th>Subject</th>
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<tr>
<td>BME</td>
<td>561L</td>
<td>Genome Science and Technology Lab (GE, MC)</td>
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</table>

**Description**

Study of the basic principles of epigenetics, genomics, and human stem cell biology as applied to medical diagnostics and tissue engineering. Focus on engineering of living systems will include collaboration with clinicians, laboratories on DNA/RNA isolation, genotyping, qPCR and stem cell culture; overview of organ on a chip technology and statistical approach to large data towards risk prediction, early detection and disease prevention. Oral and written lab reports required; select projects may be continued as independent study. Instructor consent required.

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### BME562 - Biology by Design (GE, MC)

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<tr>
<td>BME</td>
<td>562</td>
<td>Biology by Design (GE, MC)</td>
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</table>

**Description**

Engineering biological systems emphasizing synthetic biology and the application of biological/chemical principles to the design of new biomolecules and cellular pathways. Review of primary scientific literature, highlighting contemporary research in this area, including artificial amino and nucleic acids, gene regulatory systems, directed molecular evolution, recombinant antibodies, novel biosynthesis pathways, cell communication, and the design of minimal organisms. Topics are presented with applications such as drug design, discovery, productions, regenerative medicine, and bioremediation. Prerequisite: Biomedical Engineering 244L. Organic chemistry or biochemistry suggested. Instructor consent required.

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### BME563 - Transport Processes in HIV Transmission and Prevention (GE, BB, MC)

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<tr>
<td>BME</td>
<td>563</td>
<td>Transport Processes in HIV Transmission and Prevention (GE, BB, MC)</td>
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</table>

**Description**

Application of transport theory to analyze processes of HIV migration to target cells in the mucosa of the lower female reproductive tract. Analysis of the introduction, transport and bioactivity of molecules that inhibit these HIV-infection processes, including those acting topically (microbicides) and those introduced in a variety of drug delivery vehicles: semi-solid materials (gels, films) and solid materials (intravaginal rings). A succession of mathematical models will describe elements of the fundamental biology of this system and analyze the performance of specific products that act prophylactically against HIV infection. Prerequisite: Biomedical Engineering 307 or graduate student standing.

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### BME565L - Environmental Molecular Biotechnology (GE, MC)

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<tr>
<td>BME</td>
<td>565L</td>
<td>Environmental Molecular Biotechnology (GE, MC)</td>
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</table>

**Description**

Principles of genetics and recombinant DNA for environmental systems. Applications to include genetic engineering for bioremediation, DGGE, FISH, micro-arrays and biosensors. Laboratory exercises to include DNA isolation, amplification, manipulation and analysis. Prerequisites: Civil and Environmental Engineering 462L, Biology 20, Biology 201L, or graduate standing, or consent of instructor.
### BME566 - Transport Phenomena in Cells and Organs (GE, MC)

**Subject**: BME  
**Catalog Number**: 566  
**Title**: Transport Phenomena in Cells and Organs (GE, MC)

**Description**  
Applications of the principles of mass and momentum transport to the analysis of selected processes of biomedical and biotechnological interest. Emphasis on the development and critical analysis of models of the particular transport process. Topics include: reaction-diffusion processes, transport in natural and artificial membranes, dynamics of blood flow, pharmacokinetics, receptor-mediated processes and macromolecular transport, normal and neoplastic tissue. Prerequisite: Biomedical Engineering 307 or equivalent.

### BME567 - Biosensors (GE, IM, MC)

**Subject**: BME  
**Catalog Number**: 567  
**Title**: Biosensors (GE, IM, MC)

**Description**  
Theory and applications of biosensors. Basic principles of interactions between analytes and bioreceptors and various transduction techniques: optical, electrochemical, ion-selective electrode-based, voltammetric, conductometric, and mass-sensitive techniques as well as novel nanotechnology-based biosensing systems including nanosensors, plasmonic nanoprobes, quantum dots, carbon nanotubes, molecular beacons, and molecular sentinel systems. Applications in chemical, environmental, biological and medical sensing. Paired with Chemistry 601. Prerequisites: senior or graduate standing in BME or instructor’s consent.

### BME570L - Introduction to Biomolecular Engineering (GE, BB, MC)

**Subject**: BME  
**Catalog Number**: 570L  
**Title**: Introduction to Biomolecular Engineering (GE, BB, MC)

**Description**  
Techniques of molecular biology through linked lectures and laboratory exercises with emphasis on molecular tools to manipulate and analyze DNA and RNA for specific molecular bioengineering applications. Lectures cover the genetic code, replication, transcription, translation, cloning vectors for E. coli, enzymatic manipulation of DNA, gene cloning, synthetic gene design and assembly, DNA sequencing, polymerase chain reaction, site-directed mutagenesis, overexpression and purification of recombinant proteins. Laboratory exercises, linked to lectures, cover cloning, mutagenesis and recombinant protein expression and purification. Prerequisites: BIO 201L or BME 260L or graduate standing in BME.

### BME574 - Modeling and Engineering Gene Circuits (GE, MC)

**Subject**: BME  
**Catalog Number**: 574  
**Title**: Modeling and Engineering Gene Circuits (GE, MC)

**Description**  
This course discusses modeling and engineering gene circuits, such as prokaryotic gene expression, cell signaling dynamics, cell-cell communication, pattern formation, stochastic dynamics in cellular networks and its control by feedback or feedforward regulation, and cellular information processing. The theme is the application of modeling to explore "design principles" of cellular networks, and strategies to engineer such networks. Students need to define an appropriate modeling project. At the end of the course, they’re required to write up their results and interpretation in a research-paper style report and give an oral presentation. Prerequisites: Biomedical Engineering 260L or consent of instructor.
BME577 - Drug Delivery (GE, BB, MC)
Subject: BME  
Catalog Number: 577  
Title: Drug Delivery (GE, BB, MC)
Description: Introduction to drug delivery in solid tumors and normal organs (for example, reproductive organs, kidney, skin, eyes). Emphasis on quantitative analysis of drug transport. Specific topics include: physiologically-based pharmacokinetic analysis, microcirculation, network analysis of oxygen transport, transvascular transport, interstitial transport, transport across cell membrane, specific issues in the delivery of cells and genes, drug delivery systems, and targeted drug delivery. Prerequisite: Biomedical Engineering 307 and (Engineering 103L or Computer Science 201); or graduate standing.

BME578 - Quantitative Cell and Tissue Engineering (GE, BB, MC)
Subject: BME  
Catalog Number: 578  
Title: Quantitative Cell and Tissue Engineering (GE, BB, MC)
Description: This course will serve as an overview of selected topics and problems in the emerging field of tissue engineering. General topics include cell sourcing and maintenance of differentiated state, culture scaffolds, cell-biomaterials interactions, bioreactor design, and surgical implantation considerations. Specific tissue types to be reviewed include cartilage, skin equivalents, blood vessels, myocardium and heart valves, and bioartificial livers. Prerequisite: Biomedical Engineering 302L or 307 or PhD student standing.

BME580 - An Introduction to Biomedical Data Science (GE)
Subject: BME  
Catalog Number: 580  
Title: An Introduction to Biomedical Data Science (GE)
Description: This course will teach a combination of theory and application of biomedical data science principles using multi-scale biomedical data, including multi-omics, wearable sensor, and electronic health records data. Basic principles of data mining, exploratory data analysis, and statistics will be reviewed, and students will be introduced to supervised and unsupervised machine learning and model evaluation and selection methods. Methodology learned in classes will be applied in the assignments and class project to real world multi-omics, wearable sensor, and electronic health records data. Prerequisite: BME 244L or graduate standing. (GE)

BME590 - Special Topics in Biomedical Engineering
Subject: BME  
Catalog Number: 590  
Title: Special Topics in Biomedical Engineering
Description: Special subjects related to programs within biomedical engineering tailored to fit the requirements of a small group. Consent of instructor required.

BME590D - Special Topics with Discussion
Subject: BME  
Catalog Number: 590D  
Title: Special Topics with Discussion
Description: To be used as a generic course number for any special topics course with discussion sections. Instructor consent required.
BME590DL - Special Topics with Lab and Discussion

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<th>Subject</th>
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<tr>
<td>BME</td>
<td>590DL</td>
<td>Special Topics with Lab and Discussion</td>
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Description
To be used as a generic course number for any special topics course with lab and discussion sections. Instructor consent required.

BME590L - Special Topics with Lab

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<th>Subject</th>
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<tr>
<td>BME</td>
<td>590L</td>
<td>Special Topics with Lab</td>
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</table>

Description
To be used as a generic course number for any special topics course with lab sections. Instructor consent required.

BME590L-1 - Special Topics with Lab

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<th>Subject</th>
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<tr>
<td>BME</td>
<td>590L-1</td>
<td>Special Topics with Lab</td>
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</table>

Description
Half-credit special topics course.

BME601L - Introduction to Neural Engineering

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<th>Subject</th>
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<th>Title</th>
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<tr>
<td>BME</td>
<td>601L</td>
<td>Introduction to Neural Engineering</td>
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</table>

Description
Introduction to neural engineering with emphasis on the electrophysiology of neurons from a quantitative perspective. Topics include the ionic basis of action potentials, the Hodgkin-Huxley model, impulse propagation, source-field relationships, and an introduction to functional electrical stimulation. Not open to students who have taken BME 244L, 301L, 302L, 303L, or 307.

BME609 - Optics and Photonics Seminar Series

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<th>Subject</th>
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<tr>
<td>BME</td>
<td>609</td>
<td>Optics and Photonics Seminar Series</td>
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</table>

Description
Weekly seminar on the current research topics in the field of optics and photonics.

BME644 - Physiology for Engineers
BME671L - Signal Processing and Applied Mathematics

Subject: BME
Catalog Number: 671L
Title: Signal Processing and Applied Mathematics

Description: This introductory applied mathematics course for graduate students covers the basics of linear systems theory including convolutions, Fourier Series, Fourier Transforms, and Laplace Transforms with emphasis on application to biomedical systems. Students will also get a basic understanding of how to program in MATLAB as they apply the course material to process sounds, images, and other biological signals. Not open to students who have taken BME 271.
Subject: BME  
Catalog Number: 702S  
Title: BME Graduate Seminars

**Description**
Two semester, weekly seminars series required of all BME graduate students. Students are exposed to the breadth of research topics in BME via seminars given by BME faculty, advanced graduate students, and invited speakers. At the end of each semester students are required to write a synopsis of the seminars attended. More than three unexcused absences will result in a failing grade.

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Subject: BME  
Catalog Number: 703S  
Title: Engineering Management Seminar for Master of Science Students

**Description**
Current topics in applied engineering management and entrepreneurship. This course is offered to Master of Science students in BME who are interested in pursuing careers in industries. The course will consist of weekly seminar series through the EGRMGMT 501 course.

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Subject: BME  
Catalog Number: 711S  
Title: Biological Engineering Seminar Series (CBIMMS and CBTE)

**Description**
Seminar series featuring in alternate weeks invited speakers and pre-seminar discussions. Research topics in biological engineering, with emphasis on bioinspired materials and materials systems, biomolecular, and tissue engineering. Enrollment is required of all BIMMS and BTE certificate program students in their first and second year. Open to others for credit or audit. Instructor consent required.

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Subject: BME  
Catalog Number: 712S  
Title: Biological Engineering Seminar Series (CBIMMS and CBTE)

**Description**
Seminar series featuring in alternate weeks invited speakers and pre-seminar discussions. Research topics in biological engineering, with emphasis on bioinspired materials and materials systems, biomolecular, and tissue engineering. Enrollment is required of all BIMMS and BTE certificate program students in their first and second year. Open to others for credit or audit. Instructor consent required.

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Subject: BME  
Catalog Number: 728S  
Title: Teaching Seminar for New Teaching Assistants
BME729S - Teaching seminar for repeat teaching assistants

Description
This 3 credit seminar is for BME PhD students concurrently serving as a TA for the second time or later. It is mandatory for those entering the program in Fall 2015 and optional for all BME PhD students who entered the program before Fall 2015. Throughout this course, students will participate in mentoring activities designed to improve pedagogical training and support for teaching assistants. Students will practice concepts learned in the seminars during TAship. Teaching assistants will receive feedback through performance evaluations by the professor. Evaluations will be given twice per semester. The teaching assistants also complete an activity log to document time spent.

BME733 - Experimental Design and Biostatistics for Basic Biomedical Scientists

Description
The use and importance of statistical methods in laboratory science, with an emphasis on the nuts and bolts of experimental design, hypothesis testing, and statistical inference. Central tendency and dispersion, Gaussian and non-Gaussian distributions, parametric and nonparametric tests, uni- and multivariate designs, ANOVA and regression procedures. Ethical issues in data handling and presentation. Student presentations in addition to formal lectures. Intended for third-year graduate students. Instructor consent required.

BME771 - Bioconjugation in drug biomaterials and drug delivery systems

Description
Bioconjugation chemistry is the science of coupling biomolecules for a wide range of applications. For example, proteins may be coupled with one polymer to enhance its stability in serum or polymers may be coupled to each other to form hydrogels. A wide variety of bioconjugates are used in the delivery of pharmaceuticals, in sensors, in medical diagnostics, and in tissue engineering. Basic concepts of chemical ligation, including the choice and design of conjugate linkers depending on the type of biomolecule and desired application, such as degradable versus nondegradable linkers. The class will focus on biomaterial and drug delivery strategies.
BME773L - Design Health 1: Discover

Subject: BME
Catalog Number: 773L
Title: Design Health 1: Discover

Description:
First semester of a 3-semester design course sequence (BME 773L, BME 774L, BME 775L) for graduate students. Students will expand on their formal engineering design principles knowledge by applying it to identify and research a need drawn from the Duke Hospital/medical personnel, local companies and organizations around Duke University. Students will develop and determine design feasibility for a device, system, material, or process subject to real-world constraints. Recommended prerequisite: BME capstone design experience.

BME774L - Design Health 2: Design

Subject: BME
Catalog Number: 774L
Title: Design Health 2: Design

Description:
Second semester of a 3-semester design course sequence (BME 773L, 774L, 775L) for graduate students. Students will iterate their design solution drawn from the Duke Hospital/medical personnel, local companies and organizations around Duke University. Students will develop and determine design feasibility for a device, system, material, or process subject to real-world constraints. Prerequisite: BME 773L.

BME775L - Design Health 3: Deliver

Subject: BME
Catalog Number: 775L
Title: Design Health 3: Deliver

Description:
Third semester of a 3-semester design course sequence (BME 773L, BME 774L and BME 775L) for graduate students. Students will expand on their formal engineering design principles knowledge by applying it to identify and research a need drawn from the Duke Hospital/medical personnel, local companies and organizations around Duke University. Students will develop and determine design feasibility for a device, system, material, or process subject to real-world constraints. Prerequisite: BME capstone design experience, and have already taken BME 773L and BME 774L.

BME788 - Invention to Application: Healthcare Research Commercialization

Subject: BME
Catalog Number: 788
Title: Invention to Application: Healthcare Research Commercialization

Description:
Interdisciplinary teams of students from engineering, medical science, business, and medicine work together to understand and evaluate the commercial potential of Duke faculty research innovations and develop a comprehensive research translation and business plan for one chosen opportunity. Learning includes understanding technology, product development, marketing, finance, regulatory requirements, and reimbursement. In addition to weekly lectures, students are mentored in this real-world experience by a team including technology transfer experts, venture capitalists, researchers, physicians, and entrepreneurs. Prerequisites: none. Consent of instructor required.

BME789 - Internship in Biomedical Engineering
**BME789 - Internship in Biomedical Engineering**

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<th>Title</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>BME</td>
<td>789</td>
<td></td>
<td>Internship in Biomedical Engineering</td>
</tr>
</tbody>
</table>

Student gains practical biomedical engineering experience by taking a job in industry, and writing a report about this experience. Requires prior consent from the student's advisor and from the director of graduate studies. May be repeated with consent of the advisor and the director of graduate studies. Credit/no credit grading only.

**BME790 - Advanced Topics for Graduate Students in Biomedical Engineering**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME</td>
<td>790</td>
<td></td>
<td>Advanced Topics for Graduate Students in Biomedical Engineering</td>
</tr>
</tbody>
</table>

Advanced subjects related to programs within biomedical engineering tailored to fit the requirements of a small group. Consent of instructor required.

**BME790L - Advanced Topics with the Lab for Graduate Students in Biomedical Engineering**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME</td>
<td>790L</td>
<td></td>
<td>Advanced Topics with the Lab for Graduate Students in Biomedical Engineering</td>
</tr>
</tbody>
</table>

Advanced subjects related to programs within biomedical engineering tailored to fit the requirements of a small group. Consent of instructor required. Includes laboratory component.

**BME791 - Graduate Independent Study**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME</td>
<td>791</td>
<td></td>
<td>Graduate Independent Study</td>
</tr>
</tbody>
</table>

First Independent Study course in advanced study and research areas of biomedical engineering. Approval of adviser is required.

**BME792 - Continuation of Graduate Independent Study**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME</td>
<td>792</td>
<td></td>
<td>Continuation of Graduate Independent Study</td>
</tr>
</tbody>
</table>

Second independent study in advanced study and research areas of biomedical engineering. Approval of adviser is required.
This advanced course for PhD students covers the fundamentals of computational modeling of neurons and neuronal circuits and the decoding of information from populations of spike trains. Topics include: integrate and fire neurons, spike response models, homogeneous and inhomogeneous Poisson processes, neural circuits, Weiner (optimal) adaptive filters, neural networks for classification, population vector coding and decoding. Programming assignments and projects will be carried out using Python.

BME804 - Developments in Neural Engineering

The objective of this course is to provide in depth exposure to and critical analysis of current topics in neural engineering. Students will develop skills of critical reading and analysis, data synthesis and presentation, and discussion leadership. The course will serve the secondary purpose of providing exposure of our neural engineering faculty and students to leaders in the field. Instructor consent required.

BME844 - Advanced Ultrasonic Imaging

This course provides students with a mathematical basis of ultrasonic imaging methods. Topics include K-space, descriptions of ultrasonic imaging, ultrasonic beam-former design, tissue motion and blood flow imaging methods, and novel ultrasonic imaging methods. Students conduct extensive simulations of ultrasonic imaging methods. Prerequisite: Biomedical Engineering 333.

BME845 - Elasticity Imaging

Theory and practical implementation of elasticity imaging techniques, including static, dynamic, physiologic and acoustic radiation force based methods; continuum mechanics; wave propagation in soft tissues; algorithms for quantifying wave speed; and material models employed in elasticity reconstruction methods (linearity, anisotropy, and viscoelasticity); simulations tools employed during system development will be introduced, including FEM modeling approaches and ultrasonic imaging simulation tools. Assignments include weekly readings and literature reviews, weekly homework (simulations/FEM modeling tools), and a final project. Prerequisites: BME 542 and BME 530 or instructor permission.

BME848L - Radiology in Practice
# Duke University

## BME890 - Advanced topics for PhD students

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME</td>
<td>890</td>
<td>Advanced topics for PhD students</td>
</tr>
</tbody>
</table>

**Description**
Advanced subjects related to programs within biomedical engineering tailored to fit the requirements of a small group. Consent of instructor required.

## BME899 - Special Readings in Biomedical Engineering

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME</td>
<td>899</td>
<td>Special Readings in Biomedical Engineering</td>
</tr>
</tbody>
</table>

**Description**
Individual readings in advanced study and research areas of biomedical engineering. Approval of director of graduate studies required.

## CEE501 - Applied Mathematics for Engineers

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE</td>
<td>501</td>
<td>Applied Mathematics for Engineers</td>
</tr>
</tbody>
</table>

**Description**
Advanced analytical methods of applied mathematics useful in solving a wide spectrum of engineering problems. Applications of linear algebra, calculus of variations, the Frobenius method, ordinary differential equations, partial differential equations, and boundary value problems. Prerequisites: Mathematics 353 or equivalent and undergraduate courses in solid and/or fluid mechanics.

## CEE511 - Construction Management

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>CEE</td>
<td>511</td>
<td>Construction Management</td>
</tr>
</tbody>
</table>

**Description**
This course is a broad overview of the roles and responsibilities of the construction management engineer. Included in this is an examination of: Project Management Planning, Cost Management, Time Management, Quality Management, Contract Administration, and Safety Management. Topics covered will include: defining the responsibilities and management structure of the project management team, organizing and leading by implementing project controls, defining roles and responsibilities and developing communication protocols, and identifying elements of project design and construction likely to give rise to disputes and claims. Field trips.

## CEE520 - Continuum Mechanics
Subject          | Catalog Number | Title                           
---               | ---------------|---------------------------------
CEE              | 520             | Continuum Mechanics             

**Description**


---

**CEE521 - Elasticity (GE, BB)**

Subject          | Catalog Number | Title                           
---               | ---------------|---------------------------------
CEE              | 521             | Elasticity (GE, BB)             

**Description**

Linear elasticity will be emphasized including concepts of stress and strain as second order tensors, equilibrium at the boundary and within the body, and compatibility of strains. Generalized solutions to two and three dimensional problems will be derived and applied to classical problems including torsion of noncircular sections, bending of curved beams, stress concentrations and contact problems. Applications of elasticity solutions to contemporary problem in civil and biomedical engineering will be discussed. Prerequisites: Engineering 201L; Mathematics 353.

---

**CEE525 - Wave Propagation in Elastic and Poroelastic Media**

Subject          | Catalog Number | Title                           
---               | ---------------|---------------------------------
CEE              | 525             | Wave Propagation in Elastic and Poroelastic Media 

**Description**

Basic theory, methods of solution, and applications involving wave propagation in elastic and poroelastic media. Analytical and numerical solution of corresponding equations of motion. Linear elasticity and viscoelasticity as applied to porous media. Effective medium, soil/rock materials as composite materials. Gassmann's equations and Biot's theory for poroelastic media. Stiffness and damping characteristics of poroelastic materials. Review of engineering applications that include NDT, geotechnical and geophysical case histories. Prerequisite: Mathematics 353, graduate standing, or consent of instructor.

---

**CEE530 - Introduction to the Finite Element Method**

Subject          | Catalog Number | Title                           
---               | ---------------|---------------------------------
CEE              | 530             | Introduction to the Finite Element Method 

**Description**

Investigation of the finite element method as a numerical technique for solving linear ordinary and partial differential equations, using rod and beam theory, heat conduction, elastostatics and dynamics, and advective/diffusive transport as sample systems. Emphasis placed on formulation and programming of finite element models, along with critical evaluation of results. Topics include: Galerkin and weighted residual approaches, virtual work principles, discretization, element design and evaluation, mixed formulations, and transient analysis. Prerequisites: a working knowledge of ordinary and partial differential equations, numerical methods, and programming in FORTRAN or MATLAB.

---

**CEE531 - Finite Element Methods for Problems in Fluid Mechanics**
Duke University

CEE541 - Structural Dynamics

Subject: CEE
Catalog Number: 541
Title: Structural Dynamics

Description:
Formulation of dynamic models for discrete and continuous structures; normal mode analysis, deterministic and stochastic responses to shocks and environmental loading (earthquakes, winds, and waves); introduction to nonlinear dynamic systems, analysis and stability of structural components (beams and cables and large systems such as offshore towers, moored ships, and floating platforms).

CEE551 - Isotopes in Earth and Environmental Sciences

Subject: CEE
Catalog Number: 551
Title: Isotopes in Earth and Environmental Sciences

Description:
The use of stable and radioactive isotopes in earth and environmental sciences, with applications to processes including climate change, hydrology, oceanography, geology and biology. Recommended prerequisite: Introductory college chemistry and calculus.

CEE560 - Environmental Transport Phenomena

Subject: CEE
Catalog Number: 560
Title: Environmental Transport Phenomena

Description:

CEE561L - Environmental Aquatic Chemistry
Subject  
<table>
<thead>
<tr>
<th>CEE</th>
<th>CEE61L</th>
<th>Environmental Aquatic Chemistry</th>
</tr>
</thead>
</table>

**Description**
Principles of chemical equilibria and kinetics as applied in environmental engineering and science processes. Topics include acid-base equilibrium, the carbonate system, metal complexation, oxidation/reduction reactions, mineral phase solubility and surface sorption. Applied environmental systems include water treatment, soil remediation, air pollution and green engineering. Graduate-level requirements include specific laboratory work and written assignments. Open to graduate students; instructor consent required for undergraduates. Not open to students who have taken CEE 461L.

---

**CEE562L - Applied Biological Principles and Processes in Environmental Engineering**

**Subject**  
<table>
<thead>
<tr>
<th>CEE</th>
<th>CEE62L</th>
<th>Applied Biological Principles and Processes in Environmental Engineering</th>
</tr>
</thead>
</table>

**Description**
Fundamentals of microbiology as it relates to biological environmental engineering processes. Topics include microbial metabolism, microbial kinetics and stoichiometry, and bioreactor models. Applications include unit processes in wastewater treatment, bioremediation, bioreactors, waste to bioenergy. Laboratory included. Graduate-level requirements include a term paper and/or a project. Open to graduate students; instructor consent required for undergraduates. Not open to students who have taken CEE 462L.

---

**CEE563 - Chemical Fate of Organic Compounds**

**Subject**  
<table>
<thead>
<tr>
<th>CEE</th>
<th>CEE63L</th>
<th>Chemical Fate of Organic Compounds</th>
</tr>
</thead>
</table>

**Description**
This course will review environmental organic chemistry basics with a focus on contaminant chemistry. We will discuss quantitative processes used in predicting the fate and distribution of organic chemicals in the environment with regards to equilibrium/thermodynamics and some kinetic considerations. Topics include: equilibrium partitioning among air, water, sediments and biological tissues; factors affecting bioaccumulation and biomagnification; processes influencing the ultimate fate of organic contaminants in rivers and lakes; and processes influencing global transport. Prerequisites: University-level general chemistry and organic chemistry within last four years.

---

**CEE563D - Chemical Fate of Organic Compounds**

**Subject**  
<table>
<thead>
<tr>
<th>CEE</th>
<th>CEE63DL</th>
<th>Chemical Fate of Organic Compounds</th>
</tr>
</thead>
</table>

**Description**
Equilibrium, kinetic, and analytical approaches applied to quantitative description of processes affecting the distribution and fate of anthropogenic and natural organic compounds in surface and ground waters, including chemical transfers between air, water, soils/sediments, and biota; and thermochemical and photochemical transformations. The relationships between organic compound structure and environmental behavior will be emphasized. Sampling, detection, identification, and quantification of organic compounds in the environment. Prerequisite: university-level general chemistry and organic chemistry within last four years.

---

**CEE564 - Physical Chemical Processes in Environmental Engineering**

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CEE565 - Environmental Analytical Chemistry

Description
This course covers the fundamentals and applications of analytical chemistry as applied to detection, identification, and quantification of anthropogenic contaminants in environmental samples including air, water, soil, sediment, and biota. The topics include both sample preparation methods (i.e. wet chemistry) and instrumental analysis (e.g. mass spectrometry, chromatography, and optical spectroscopy). Particular emphasis is placed on current advancements in measurement science as applied to environmental chemistry. The material includes both theoretical and practical aspects of environmental analysis. Prerequisite: CHEM 131 or CHEM 151L or consent of instructor.

CEE566 - Environmental Microbiology

Description
Fundamentals of microbiology and biochemistry as they apply to environmental engineering. General topics include cell chemistry, microbial metabolism, bioenergetics, microbial ecology and pollutant biodegradation. Prerequisites: Civil and Environmental Engineering 462L or graduate standing or consent of the instructor.

CEE574 - Remote Sensing in Coastal Environments

Description
Introduction to the field of remote sensing and image processing with focus on applications to coastal monitoring and currently open research questions. Students will acquire an operational knowledge of various remote-sensing tools and data types, with emphasis on their application in coastal areas. Content will include theory, in-class laboratory exercises, and projects with environmental applications. Prerequisite: introductory or AP physics preferred or permission of instructor.

CEE575 - Air Pollution Engineering
Conclusion

Duke University

Subject      | Catalog Number | Title
---          | ---            | ---
CEE          | 575            | Air Pollution Engineering

Description
Introduction to air pollutants. Upon completion, students will have a knowledge of which air pollutants are of concern, their source, fate, atmospheric transport and transformation and policies developed to help manage the problem. Topics include: air pollutants of importance, air pollution impacts, sources of air pollutants, atmospheric transport (including dispersion and deposition), atmospheric chemistry, aerosol chemistry and physics, control strategy development and air pollution management. Additionally, the course covers indoor air pollution with an emphasis on issues related to airborne viral disease emission, transport, and infection. Prerequisite: Chemistry 20, 21, or 101DL, or graduate standing.

CxEE581 - Pollutant Transport Systems

Subject      | Catalog Number | Title
---          | ---            | ---
CEE          | 581            | Pollutant Transport Systems

Description
Distribution of pollutants in natural waters and the atmosphere; diffusive and advective transport phenomena within the natural environment and through artificial conduits and storage/treatment systems. Analytical and numerical prediction methods. Prerequisite: Civil and Environmental Engineering 301L and Mathematics 353, or equivalents.

CEE621 - Plasticity

Subject      | Catalog Number | Title
---          | ---            | ---
CEE          | 621            | Plasticity

Description

CEE622 - Fracture Mechanics

Subject      | Catalog Number | Title
---          | ---            | ---
CEE          | 622            | Fracture Mechanics

Description
Theoretical concepts concerning the fracture and failure of brittle and ductile materials. Orowan and Griffith approaches to strength. Determination of stress intensity factors using compliance method, weight function method, and numerical methods with conservation laws. Cohesive zone models, fracture toughness, crack growth stability, and plasticity. Prerequisites: Civil and Environmental Engineering 520, or instructor consent.

CEE625 - Intermediate Dynamics: Dynamics of Very High Dimensional Systems
Duke University

CEE626 - Energy Flow and Wave Propagation in Elastic Solids

Subject: CEE
Catalog Number: 626
Title: Energy Flow and Wave Propagation in Elastic Solids

Description:
Derivation of equations for wave motion in simple structural shapes: strings, longitudinal rods, beams and membranes, plates and shells. Solution techniques, analysis of systems behavior. Topics covered include: nondispersive and dispersive waves, multiple wave types (dilational, distortion), group velocity, impedance concepts including driving point impedances and moment impedances. Power and energy for different cases of wave propagation. Prerequisites: Engineering 244L and Mathematics 353 or consent of instructor.

CEE627 - Linear System Theory

Subject: CEE
Catalog Number: 627
Title: Linear System Theory

Description:
Construction of continuous and discrete-time state space models for engineering systems, and linearization of nonlinear models. Applications of linear operator theory to system analysis. Dynamics of continuous and discrete-time linear state space systems, including time-varying systems. Lyapunov stability theory. Realization theory, including notion of controllability and observability, canonical forms, minimal realizations, and balanced realizations. Design of linear feedback controllers and dynamic observers, featuring both pole placement and linear quadratic techniques. Introduction to stochastic control and filtering. Prerequisites: Electrical and Computer Engineering 382 or Mechanical Engineering 344, or consent of instructor.

CEE628 - Uncertainty Quantification in Computational Science and Engineering

Subject: CEE
Catalog Number: 628
Title: Uncertainty Quantification in Computational Science and Engineering

Description:
This course is concerned with the modeling, identification, and propagation of model and parametric uncertainties in computational science and engineering. The aim is to provide decision makers, engineers and scientists with predictions endowed with measures of confidence. In practice, the randomness introduced within the modeling framework can reflect intrinsic stochasticity or some lack of knowledge. The covered material finds applications in a broad range of fields, from the modeling of materials and complex systems to robust design optimization. The course is oriented towards the understanding and implementation of state-of-the-art techniques for applied or fundamental research projects.
**CEE629 - System Identification**

**Subject**
CEE

**Catalog Number**
629

**Title**
System Identification

**Description**
Numerical linear algebra for modeling and filtering data (FFT, SVD, QR, and PCA); ordinary least squares, total least squares, and recursive least squares; measurement noise and propagation of measurement error; regularization; optimal linear filtering; state-space models, eigensystem realization, deterministic and stochastic subspace identification through projections and canonical correlation. Applications drawn from engineering, natural sciences, and finance.

---

**CEE630 - Nonlinear Finite Element Analysis**

**Subject**
CEE

**Catalog Number**
630

**Title**
Nonlinear Finite Element Analysis

**Description**
Formulation and solution of nonlinear initial/boundary value problems using the finite element method. Systems include nonlinear heat conduction/diffusion, geometrically nonlinear solid and structural mechanics applications, and materially nonlinear systems (for example, elastoplasticity). Emphasis on development of variational principles for nonlinear problems, finite element discretization, and equation-solving strategies for discrete nonlinear equation systems. Topics include: Newton-Raphson techniques, quasi-Newton iteration schemes, solution of nonlinear transient problems, and treatment of constraints in a nonlinear framework. An independent project, proposed by the student, is required. Prerequisite: Civil and Environmental Engineering 530/Mechanical Engineering 524, or consent of instructor.

---

**CEE635 - Computational Methods for Evolving Discontinuities**

**Subject**
CEE

**Catalog Number**
635

**Title**
Computational Methods for Evolving Discontinuities

**Description**
Presents an overview of advanced numerical methods for the treatment of engineering problems such as brittle and ductile failure and solid-liquid phase transformations in pure substances. Analytical methods for arbitrary discontinuities and interfaces are reviewed, with particular attention to the derivation of jump conditions. Partition of unity and level set methods. Prerequisites: Civil and Environmental Engineering 530, or 630, or instructor consent.

---

**CEE642 - Environmental Geomechanics**

**Subject**
CEE

**Catalog Number**
642

**Title**
Environmental Geomechanics

**Description**
The course addresses engineered and natural situations, where mechanical and hydraulic properties of soils and rocks depend on environmental (thermal chemical, biological) processes. Experimental findings are reviewed, and modeling of coupled thermo-mechanical, chemo-mechanical technologies are reviewed.

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**CEE643 - Environmental and Engineering Geophysics**
### CEE644 - Inverse Problems in Geosciences and Engineering

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
</table>

### CEE647 - Buckling of Engineering Structures

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE</td>
<td>647</td>
<td>Buckling of Engineering Structures</td>
<td>An introduction to the underlying concepts of elastic stability and buckling, development of differential equation and energy approaches, buckling of common engineering components including link models, struts, frames, plates, and shells. Consideration will also be given to inelastic behavior, postbuckling, and design implications.</td>
</tr>
</tbody>
</table>

### CEE649 - Structural Engineering Project Management

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE</td>
<td>649</td>
<td>Structural Engineering Project Management</td>
<td>Apply project management tools and skills to a structural engineering design project. Implement changes in schedule, budget, and changing client and/or regulatory climate. Work with a design team of undergraduate students. Prerequisites: not open to students who have had Civil and Environmental Engineering 429, 469, or 679. Consent of instructor required.</td>
</tr>
</tbody>
</table>

### CEE661L - Environmental Molecular Biotechnology (GE, MC)
### Duke University

#### CEE666 - Aquatic Geochemistry

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE</td>
<td>666</td>
<td>Aquatic Geochemistry</td>
</tr>
</tbody>
</table>

**Description**

Geochemistry of the water-solid interface of soils, minerals, and particles in earth systems. Topics will cover the chemical composition of soils, geochemical speciation, mineral weathering and stability, sorption and ion exchange, soil redox processes, and chemical kinetics at environmental surfaces. Prerequisites: CEE 461L or CEE 561L/ENVIRON 542L or permission of instructor.

#### CEE667 - Chemical Transformation of Environmental Contaminants

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE</td>
<td>667</td>
<td>Chemical Transformation of Environmental Contaminants</td>
</tr>
</tbody>
</table>

**Description**

Mechanisms and principles underlying organic contaminant transformations in the ambient environment. Topics include hydrolysis, oxidation/reduction, direct and indirect photolysis, and reactions with disinfectant chemicals. Reactions will be considered in context of both natural (e.g. surface water and cloudwater) and engineered (e.g. drinking water, wastewater, and groundwater remediation) systems. Approaches will include both qualitative (reaction mechanism and product identification) as well as quantitative (reaction kinetics and stoichiometry) aspects of environmental reaction chemistry. Prerequisites: CEE 563/ENVIRON 540 or one semester of organic chemistry.

#### CEE675 - Introduction to the Physical Principles of Remote Sensing of the Environment

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE</td>
<td>675</td>
<td>Introduction to the Physical Principles of Remote Sensing of the Environment</td>
</tr>
</tbody>
</table>

**Description**

The course provides an overview of the radiative transfer principles used in remote-sensing across the electromagnetic spectrum using both passive and active sensors. Special focus is placed on the process that leads from theory to the development of retrieval algorithms for satellite-based sensors, including post-processing of raw observations and uncertainty analysis. Students carry on three hands-on projects (Visible and Thermal Infrared, Active Microwave, and Passive Microwave). Background in at least one of the following disciplines is desirable: radiation transfer, signal processing, and environmental physics (Hydrology, Geology, Geophysics, Plant Biophysics, Soil Physics). Instructor consent required.

#### CEE679 - Environmental Engineering Project Management
Subject | Catalog Number | Title
--- | --- | ---
CEE | 679 | Environmental Engineering Project Management

**Description**
Apply project management tools and skills to an environmental engineering design project. Implement changes in schedule, budget, and changing client and/or regulatory climate. Work with a design team of undergraduate students. Consent of instructor required. Prerequisites: not open to students who have had Civil and Environmental Engineering 429, 469, or 649.

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**CEE683 - Groundwater Hydrology and Contaminant Transport**

Subject | Catalog Number | Title
--- | --- | ---
CEE | 683 | Groundwater Hydrology and Contaminant Transport

**Description**

---

**CEE684 - Physical Hydrology and Hydrometeorology**

Subject | Catalog Number | Title
--- | --- | ---
CEE | 684 | Physical Hydrology and Hydrometeorology

**Description**
The objective of this course is to introduce and familiarize graduate students with the fundamental physical processes in Hydrology and Hydrometeorology that control and modulate the pathways and transformations of water in the environment. The content of the course will be strongly oriented toward providing students with a specific basis for quantitative analysis of the terrestrial water cycle including land-atmosphere interactions and clouds and precipitation (rain and snow) processes. The course should be of interest to undergraduate and graduate students interested in Environmental Science and Engineering, and Atmospheric and Earth Sciences.

---

**CEE686 - Ecohydrology**

Subject | Catalog Number | Title
--- | --- | ---
CEE | 686 | Ecohydrology

**Description**
This course provides the theoretical basis for understanding the interaction between hydrologic cycle, vegetation and soil biogeochemistry which is key for a proper management of water resources and terrestrial ecosystems especially in view of the possible intensification and alteration of the hydrologic regime due to climate change. Topics include: Probabilistic soil moisture dynamics; plant water stress; coupled dynamics of soil moisture, transpiration and photosynthesis; and infiltration, root uptake, and hydrologic control on soil biogeochemistry.

---

**CEE688 - Turbulence 1**
### CEE690 - Advanced Topics in Civil and Environmental Engineering

**Subject**
CEE

**Catalog Number**
690

**Title**
Advanced Topics in Civil and Environmental Engineering

**Description**
A course on an advanced topic within the civil and environmental engineering department.

### CEE691 - Independent Study: Advanced Topics in Civil and Environmental Engineering

**Subject**
CEE

**Catalog Number**
691

**Title**
Independent Study: Advanced Topics in Civil and Environmental Engineering

**Description**
Study arranged on an advanced subject relating to programs within the civil and environmental engineering department tailored to fit the requirements of individuals or small groups. Consent of director of graduate studies required.

### CEE692 - Independent Study: Advanced Topics in Civil and Environmental Engineering

**Subject**
CEE

**Catalog Number**
692

**Title**
Independent Study: Advanced Topics in Civil and Environmental Engineering

**Description**
Study arranged on an advanced subject relating to programs within the civil and environmental engineering department tailored to fit the requirements of individuals or small groups. Consent of director of graduate studies required.

### CEE701 - Graduate Colloquium

**Subject**
CEE

**Catalog Number**
701

**Title**
Graduate Colloquium

**Description**

---

Duke University

This is an introductory course on the subject of turbulence in fluids. The focus is on understanding the fundamental physical processes and mechanisms governing the behavior of turbulent flows. The course covers the following - overview of physical and mathematical properties of Navier-Stokes equation; kinematics, dynamics and energetics of turbulent flows; Kolmogorov theories of turbulence; Richardson energy cascade; wall-bounded turbulent flows; particle dispersion, clustering and collisions in turbulent flows. Prerequisite: (CEE 301L or ME 336L) and Mathematics 353) or graduate standing. Recommended prerequisite: an introductory course on fluid mechanics, and a course on differential equations.
CEE702 - Graduate Colloquium
Subject: CEE  
Catalog Number: 702  
Title: Graduate Colloquium
Description: Current topics in civil and environmental engineering theory and practice. Weekly seminar series.

CEE761 - Hydrologic and Environmental Data Analysis
Subject: CEE  
Catalog Number: 761  
Title: Hydrologic and Environmental Data Analysis
Description: Course will focus on acquisition of skills necessary to extract information from observations of hydrological and environmental processes, connect the extracted information with the physical processes generating the data, and estimate physical quantities at ungauged location/times. Emphasis on process understanding via data analysis techniques. Applications used as a way to understand the general concepts, with examples drawn from water science. Prerequisites: Basic computer skills, Algebra, Calculus are required. Experience with computational software (e.g. Matlab or R) is helpful but not required.

CEE780 - Internship
Subject: CEE  
Catalog Number: 780  
Title: Internship
Description: Student gains practical experience in civil and environmental engineering by taking a job in industry, and writes a report about this experience. Requires prior consent from the student's advisor and from the director of graduate studies.

CEE890 - Advanced Topics in Civil & Environmental Engineering
Subject: CEE  
Catalog Number: 890  
Title: Advanced Topics in Civil & Environmental Engineering
Description: A course on an advanced topic within the civil and environmental engineering department.

CEE891 - Independent Study: Advanced Topics in CEE
Subject: CEE  
Catalog Number: 891  
Title: Independent Study: Advanced Topics in CEE
Description: Special individual readings in a specific area of study in civil and environmental engineering. Approval of director of graduate studies required.

CEE892 - Independent Study: Advanced Topics in CEE
The document contains descriptions of various courses related to cybersecurity and environmental engineering. Here are the summaries of each course:

**CYBERSEC500 - Introduction to Cybersecurity Perspectives**

- **Subject**: CYBERSEC
- **Catalog Number**: 500
- **Title**: Introduction to Cybersecurity Perspectives
- **Description**: Introduction to Cybersecurity Perspectives will introduce or re-acquaint the students with the cybersecurity challenges organizations face today, providing an overview of the domains, concepts and elements needed to provide the foundation for a well-performing cyber organization.

**CYBERSEC501 - Seminar**

- **Subject**: CYBERSEC
- **Catalog Number**: 501
- **Title**: Seminar
- **Description**: Current topics in applied cybersecurity. Weekly seminar series.

**CYBERSEC502 - Cybersecurity and Interdisciplinary Law/Ethics/Policy/Privacy Considerations**

- **Subject**: CYBERSEC
- **Catalog Number**: 502
- **Title**: Cybersecurity and Interdisciplinary Law/Ethics/Policy/Privacy Considerations
- **Description**: This course will introduce students to the legal, regulatory and policy topics that relate to cybersecurity, privacy and emerging technologies, and will provide (1) an overview of today’s threat landscape, the legal frameworks governing data breaches, cybercrime and cyberwarfare; (2) an examination of data privacy laws and the issues surrounding governments’ collection of personal data; and (3) an exploration of the impact emerging technologies have on regulatory agencies and public and private policies.

**CYBERSEC503 - Cybersecurity Risk Management**

- **Subject**: CYBERSEC
- **Catalog Number**: 503
- **Title**: Cybersecurity Risk Management
- **Description**: Understanding and measuring risk is fundamental to protect an organization or enterprise from real and potential cybersecurity threats. Students will learn and apply various modeling techniques used to identify and quantify risk and explore how they are used to determine the value and criteria for managing risk. Risk management concepts and standards, including essential elements, effective governance, appetite for risk, and the need to develop appropriate policies and procedures to mitigate risk, will be explored across different industries and environments.
### CYBERSEC504 - Introductory Residency

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<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
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<tbody>
<tr>
<td>CYBERSEC</td>
<td>504</td>
<td>Introductory Residency</td>
</tr>
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</table>

**Description**

One-week course to introduce the Master of Engineering Cybersecurity Online Program. Residency 1 includes an orientation to Duke and the program, business simulations, case studies, professional development workshops and alumni engagement opportunities. Open only to students in the Master of Engineering Cybersecurity Online Program.

### CYBERSEC505 - Mid-Program Residency

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<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
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<tbody>
<tr>
<td>CYBERSEC</td>
<td>505</td>
<td>Mid-Program Residency</td>
</tr>
</tbody>
</table>

**Description**

One-week course to assess interim progress for the Master of Engineering Cybersecurity Online Program. Residency 2 includes team-building exercises, case studies, leadership training, workshops, seminars and engagement opportunities. Prerequisite: CYBERSEC 504. Open only to students in the Master of Engineering Cybersecurity Online Program.

### CYBERSEC506 - Concluding Residency

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<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
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<tbody>
<tr>
<td>CYBERSEC</td>
<td>506</td>
<td>Concluding Residency</td>
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</table>

**Description**

One-week course to conclude the Master of Engineering Cybersecurity Online Program. Residency 3 includes internship presentations, team-building exercises, case studies, leadership training, professional development workshops, and exit interviews. Prerequisite: CYBERSEC 505. Open only to students in the Master of Engineering Cybersecurity Online Program.

### CYBERSEC510 - Security Incident Detection, Response, and Resilience

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<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
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<tbody>
<tr>
<td>CYBERSEC</td>
<td>510</td>
<td>Security Incident Detection, Response, and Resilience</td>
</tr>
</tbody>
</table>

**Description**

Current and emerging technologies and processes to monitor, detect and respond to security incidents in systems, networks, and clouds will be covered including automation and analytics. Best practices for developing effective incident response plans, including regulatory and legal considerations, will be studied. Also studied is how to build resilience into development, manufacturing, or other business processes in the case of an incident.

### CYBERSEC520 - Applying Machine Learning to Advance Cybersecurity
Duke University

**CYBERSEC521 - Cybersecurity Program Development, Operations & Analysis**

**Description**

This course is designed to provide students hands on experience with machine learning, particularly in cybersecurity applications. This course will delve into the historical, current, and future applications of this technology in broad domains, including network defense and disinformation campaigns. Students will learn about state-of-the-art techniques being deployed today in security products, as well as burgeoning research areas for future growth. Students will also be exposed to the adversarial mindset and introduced to techniques seeking to disrupt defensive machine learning applications.

**CYBERSEC520 - Applying Machine Learning to Advance Cybersecurity**

**Description**

To effectively prepare and respond to the ever-increasing and evolving cyberattacks, organizations must not only have a comprehensive plan but also execute that plan with great precision and consistency. Cybersecurity readiness is a critical and distinctive organizational competency, and this course is designed to enhance managerial awareness and capability to develop and sustain this competency. The course will provide a holistic and comprehensive insight into the different aspects of cybersecurity program management from development to administration, evaluation, and improvement of processes.

**CYBERSEC530 - Identity and Access Management**

**Description**

This course will explore the everyday tasks and procedures that the IT security team employs to manage user and admin identities for authentication and access management. Students will learn the latest technologies and practices for multifactor authentication, single sign-on, and real-time privileges administration and what are the best practices for different use cases.

**CYBERSEC531 - The Human Element in Cybersecurity**

**Description**

This course will examine the challenges associated with humans using, managing, and manipulating socio-technical systems with cybersecurity vulnerabilities. Technology and policy defenses and mitigations will be explored as well as societal, ethical, and legal implications of cybersecurity interventions.

**CYBERSEC590 - Advanced Topics in Cybersecurity**

**Description**

Opportunity for study of advanced subjects related to programs within cybersecurity tailored to fit the requirements of a small group. Permission of instructor required.
**CYBERSEC590L - Advanced Topics in Cybersecurity with Lab**

**Subject**  
CYBERSEC  
**Catalog Number**  
590L  
**Title**  
Advanced Topics in Cybersecurity with Lab

**Description**  
Opportunity for study of advanced subjects with laboratory related to programs within cybersecurity tailored to fit the requirements of a small group. Instructor consent required.

**CYBERSEC591 - Special Readings in Cybersecurity**

**Subject**  
CYBERSEC  
**Catalog Number**  
591  
**Title**  
Special Readings in Cybersecurity

**Description**  
Individual readings in advanced study and research areas of cybersecurity. Consent of instructor required.

**ECE511 - Foundations of Nanoscale Science and Technology**

**Subject**  
ECE  
**Catalog Number**  
511  
**Title**  
Foundations of Nanoscale Science and Technology

**Description**  
This course is the introductory course for the Graduate Certificate Program in Nanoscience (GPNANO) and is designed to introduce students to the interdisciplinary aspects of nanoscience by integrating important components of the broad research field together. This integrated approach will cross the traditional disciplines of biology, chemistry, electrical & computer engineering, computer science, and physics. Fundamental properties of materials at the nanoscale, synthesis of nanoparticles, characterization tools, and self-assembly. Prerequisites: Physics 152L and Chemistry 101DL or instructor approval.

**ECE512 - Emerging Nanoelectronic Devices**

**Subject**  
ECE  
**Catalog Number**  
512  
**Title**  
Emerging Nanoelectronic Devices

**Description**  
Brief review of semiconductor device physics followed by coverage of the most prominent emerging nanoelectronic devices. Topics include: nanoelectronic logic devices (advanced silicon transistors, carbon nanotube transistors, spintronics, 2D FETs, NEMS, tunnel FETs, negative capacitance FETs and piezoelectronics), and nanoelectronic memory devices (phase change, spin transfer torque, nanomechanical, ferroelectric FET, and molecular memory). Students will understand basic operation, pros/cons of performance, and primary integration challenges. Students conduct case study project, culminating with class presentation. Prerequisite: ECE 230L or graduate student standing.

**ECE520 - Graduate Introduction to Quantum Engineering**
Duke University

ECE521 - Quantum Mechanics

Subject: ECE
Catalog Number: 520
Title: Graduate Introduction to Quantum Engineering

Description
Quantum mechanics was discovered at the beginning of the 20th century and has had a profound effect on the development of modern technology. This course is about the potential for quantum technologies in the 21st century. The focus of the course this semester will be a survey of quantum computation, a field that promises to revolutionize the way we compute by using the dynamics of quantum mechanics. Topics include quantum circuits, introduction to quantum algorithms, hardware, and architectures. Prerequisite: [ECE 270DL and ECE 280L and one of (Math 216, 218D-1, 218D-2, or 221)] or graduate standing. Not open to students who have taken ECE 420.

ECE522 - Introduction to Micro-Electromechanical Systems (MEMS)

Subject: ECE
Catalog Number: 522
Title: Introduction to Micro-Electromechanical Systems (MEMS)

Description
Design, simulation, fabrication, and characterization of micro-electromechanical systems (MEMS) devices. Integration of non-conventional devices into functional systems. Principles of fabrication, mechanics in micrometer scale, transducers and actuators, and issues in system design and integration. Topics presented in the context of example systems. Lab covers design, simulation, and realization of MEMS devices using commercially available foundry process. Prerequisite: Electrical and Computer Engineering 230L or Mechanical Engineering 344L or equivalent.

ECE523 - Quantum Computing

Subject: ECE
Catalog Number: 523
Title: Quantum Computing

Description
Fundamental concepts and progress in quantum information science. Quantum circuits, quantum universality theorem, quantum algorithms, quantum operations and quantum error correction codes, fault-tolerant architectures, security in quantum communications, quantum key distribution, physical systems for realizing quantum logic, quantum repeaters and long-distance quantum communication. Prerequisites: Electrical and Computer Engineering 521 or Physics 464 or equivalent.

ECE524 - Introduction to Solid-State Physics
# ECE524 - Introduction to Solid-State Physics

**Subject**  
ECE  

**Catalog Number**  
524  

**Title**  
Introduction to Solid-State Physics  

**Description**  
Discussion of solid-state phenomena including crystalline structures, X-ray and particle diffraction in crystals, lattice dynamics, free electron theory of metals, energy bands, and superconductivity, with emphasis on understanding electrical and optical properties of solids. Prerequisite: quantum physics at the level of Physics 264L or Electrical and Computer Engineering 521.

# ECE526 - Semiconductor Devices for Integrated Circuits

**Subject**  
ECE  

**Catalog Number**  
526  

**Title**  
Semiconductor Devices for Integrated Circuits  

**Description**  
Basic semiconductor properties (energy-band structure, effective density of states, effective masses, carrier statistics, and carrier concentrations). Electron and hole behavior in semiconductors (generation, recombination, drift, diffusion, tunneling, and basic semiconductor equations). Current-voltage, capacitance-voltage, and static and dynamic models of PN Junctions, Schottky barriers, Metal/Semiconductor Contacts, Bipolar-Junction Transistors, MOS Capacitors, MOS-Gated Diodes, and MOS Field-Effect Transistors. SPICE models and model parameters. Prerequisites: Electrical and Computer Engineering 330L.

# ECE528 - Integrated Circuit Engineering

**Subject**  
ECE  

**Catalog Number**  
528  

**Title**  
Integrated Circuit Engineering  

**Description**  
Basic processing techniques and layout technology for integrated circuits. Photolithography, diffusion, oxidation, ion implantation, and metallization. Design, fabrication, and testing of integrated circuits. Prerequisite: Electrical and Computer Engineering 330L or 331L.

# ECE529 - Digital Integrated Circuits

**Subject**  
ECE  

**Catalog Number**  
529  

**Title**  
Digital Integrated Circuits  

**Description**  
Analysis and design of digital integrated circuits in deep submicron MOS technology. Brief review of IC technology, MOSFETs, and interconnects. Switching characteristics (propagation delay) and power consumption in NMOS/CMOS devices and interconnects. Analysis of static and dynamic logic circuits (inverters, gates) and memory circuits (SRAMs, DRAMs, Flash). Influence of technology and device structure on performance and reliability of digital ICs. SPICE modeling. Memory array design project. Prerequisite: Electrical and Computer Engineering 331L or graduate student standing.

# ECE531 - Power Electronic Circuits for Energy Conversion
ECE532 - Analog Integrated Circuit Design

Subject: ECE  
Catalog Number: 532  
Title: Analog Integrated Circuit Design

Description:
Design and layout of CMOS analog integrated circuits. Qualitative review of the theory of pn junctions, bipolar and MOS devices, and large and small signal models. Emphasis on MOS technology. Continuous time operational amplifiers. Frequency response, stability and compensation. Complex analog subsystems including phase-locked loops, A/D and D/A converters, switched capacitor simulation, layout, extraction, verification, and MATLAB modeling. Projects make extensive use of full custom VLSI CAD software. Prerequisite: [(ECE 330L or 331L) and ECE 230L and 250D and 270DL and 280L and (Mathematics 353 or 356) and (Statistical Science 130L or Mathematics 230 or ECE 555 or ECE 380 or Statistical Science 240L or EGR 238L or Mathematics 340) and (Physics 152L or 26) and (Chemistry 101DL or 20 or 21)] or graduate student standing.

ECE533 - Biochip Engineering

Subject: ECE  
Catalog Number: 533  
Title: Biochip Engineering

Description:
A problem-solving course in which students consider technology options for a complete lab-on-a-chip design. Lectures cover the basics of analog flow microfluidic devices, digital microfluidic devices, fabrication technologies for discrete devices, system integration issues, and a significant emphasis on biological applications for analysis, sample preparation, and detection issues. Technologies covered will include microfluidic devices, electrophoresis, analytical methods used in genetics, sample preparation methods, and analyte detection. Prerequisites: Biology 201L, Chem 101DL, and Physics 152L (or equivalents).

ECE538 - VLSI System Testing

Subject: ECE  
Catalog Number: 538  
Title: VLSI System Testing

Description:
Fault modeling, fault simulation, test generation algorithms, testability measures, design for testability, scan design, built-in self-test, system-on-a-chip testing, memory testing. Prerequisite: Electrical and Computer Engineering 350L or equivalent.

ECE539 - CMOS VLSI Design Methodologies
Duke University

Subject  | Catalog Number | Title                          |
---------|---------------|-------------------------------|
ECE      | 539           | CMOS VLSI Design Methodologies |

**Description**
Emphasis on full-custom digital ASIC design using CMOS technology. Extensive use of CAD tools for IC design, simulation, and layout verification. Includes techniques for designing high-speed, low-power, easily-testable circuits. Semester design project: Student groups design and simulate simple custom IC using Mentor Graphics CAD tools. Formal project proposal, written project report, and formal project presentation required. Prerequisite: [ECE 350L, 331L, 230L, 250D, 270DL, and 280L and (Mathematics 353 or 356) and (Statistical Science 130L or Statistical Science 240L or Mathematics 230 or Mathematics 340 or ECE 380 or ECE 555 or EGR 238L) and (Physics 152L or 26) and (Chemistry 101DL or 20 or 21)] or graduate-student standing.

**ECE 541 - Advanced Optics**

Subject  | Catalog Number | Title                          |
---------|---------------|-------------------------------|
ECE      | 541           | Advanced Optics               |

**Description**
This course presents a rigorous treatment of topics in Photonics and Optics targeted at students with an existing photonics or optics background. Topics will include, Optical Sources, Statistical Optics and Coherence Theory, Detection of Radiation; Nonlinear Optics; Waveguides and Optical Fibers; Modern Optical Modulators; Ultrafast lasers and Applications. These topics will be considered individually and then from a system level perspective. Prerequisite: Electrical and Computer Engineering 340L or equivalent.

**ECE 542 - Holography and Coherent Imaging**

Subject  | Catalog Number | Title                          |
---------|---------------|-------------------------------|
ECE      | 542           | Holography and Coherent Imaging |

**Description**
Coherent imaging techniques generate images based on measurements of the amplitude/phase of the electromagnetic field rather than the time averaged energy flow (irradiance). In some frequency ranges, there exist technologies that allow for direct measurement of amplitude and phase, however, at higher frequencies only irradiance sensitive detectors exist. Here, coherent imaging requires the use of techniques like holography and interferometry that encode information about the amplitude/phase into the irradiance. This course examines coherent imaging in both these regimes and develops an understanding of the associated performance limits. Prerequisite: ECE 270DL or graduate student standing.

**ECE 543 - Statistical Optics**

Subject  | Catalog Number | Title                          |
---------|---------------|-------------------------------|
ECE      | 543           | Statistical Optics            |

**Description**
Theoretical treatment of the statistical nature of optical fields via concepts such as second-order spatial and temporal coherence. Especially focuses on the theory of partial coherence and its applications including imaging with partially coherent light, laser speckle, and propagation through turbid/random media. Prerequisite: ECE 270DL or graduate student standing.

**ECE 545 - Foundations of Nanoelectronics & Nanophotonics**
ECE545 - Foundations of Nanoelectronics & Nanophotonics

**Description**
Theory and applications of nanoelectronics and nanophotonics. Quantum dots and wells, metal nanoparticles, organic-inorganic interfaces, graphene, next generation transistors, light emitters, and sensors. Prerequisite: Electrical and Computer Engineering 230L and 270DL or equivalent.

ECE546 - Optoelectronic Devices

**Description**
Devices for conversion of electrons to photons and photons to electrons. Optical processes in semiconductors: absorption, spontaneous emission and stimulated emission. Light-emitting diodes (LEDs), semiconductor lasers, quantum-well emitters, photodetectors, modulators and optical fiber networks. Prerequisite: Electrical and Computer Engineering 526 or equivalent.

ECE549 - Optics and Photonics Seminar Series

**Description**
Weekly seminar on the current research topics in the field of optics and photonics.

ECE550D - Fundamentals of Computer Systems and Engineering

**Description**
Fundamentals of computer systems and engineering for master's students whose undergraduate background did not cover this material. Topics covered include: Digital logic, assembly programming, computer architecture, memory hierarchies and technologies, IO, hardware implementation in VHDL, operating systems, and networking. Undergraduates may not take this course and should take ECE 250D, 353, and/or 356 instead. Corequisite: ECE 551D.

ECE550K - Fundamentals of Computer Systems and Engineering

**Description**
Fundamentals of computer systems and engineering for Master's students whose undergraduate background did not cover this material. Topics covered include: Digital logic, assembly programming, computer architecture, memory hierarchies and technologies, IO, hardware implementation in VHDL, operating systems, and networking. Taught at Duke Kunshan University in Kunshan, China. Corequisite: ECE 551DK.
**ECE551D - Programming, Data Structures, and Algorithms in C++**

**Subject**
ECE

**Catalog Number**
551D

**Title**
Programming, Data Structures, and Algorithms in C++

**Description**
Students learn to program in C and C++ with coverage of data structures (linked lists, binary trees, hash tables, graphs), Abstract Data Types (Stacks, Queues, Maps, Sets), and algorithms (sorting, graph search, minimal spanning tree). Efficiency of these structures and algorithms is compared via Big-O analysis. Brief coverage of concurrent (multi-threaded) programming. Emphasis is placed on defensive coding, and use of standard UNIX development tools in preparation for students’ entry into real world software development jobs. Not open to undergraduates.

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**ECE551K - Programming, Data Structures, and Algorithms in C++**

**Subject**
ECE

**Catalog Number**
551K

**Title**
Programming, Data Structures, and Algorithms in C++

**Description**
Students learn to program in C and C++ with coverage of data structures (linked lists, binary trees, hash tables, graphs), Abstract Data Types (Stacks, Queues, Maps, Sets), and algorithms (sorting, graph search, minimal spanning tree). Efficiency of these structures and algorithms is compared via Big-O analysis. Brief coverage of concurrent (multi-threaded) programming. Emphasis is placed on defensive coding, and use of standard UNIX development tools in preparation for students’ entry into real world software development jobs. Taught at Duke Kunshan University in Kunshan, China.

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**ECE552 - Advanced Computer Architecture I**

**Subject**
ECE

**Catalog Number**
552

**Title**
Advanced Computer Architecture I

**Description**
Fundamental aspects of advanced computer architecture design and analysis. Topics include processor design, pipelining, superscalar, out-of-order execution, caches (memory hierarchies), virtual memory, storage systems, simulation techniques, technology trends and future challenges. Prerequisite: Computer Science 250 or Electrical and Computer Engineering 350 or equivalent.

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**ECE553 - Compiler Construction**

**Subject**
ECE

**Catalog Number**
553

**Title**
Compiler Construction

**Description**
Covers the fundamentals of compiler design. Students will develop a working compiler, writing all stages required to take source code as input and produce working assembly as output: lexical analysis, parsing, type checking, translation to intermediate representation, instruction selection, liveness analysis, and register allocation. Students are expected to have a strong programming background prior to taking this course, as writing a compiler is a significant programming task. Prerequisites: Electrical and Computer Engineering 250L or Computer Science 250 or (ECE 550D and ECE 551D).

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**ECE554 - Fault-Tolerant and Testable Computer Systems**
Duke University

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<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
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<tbody>
<tr>
<td>ECE</td>
<td>554</td>
<td>Fault-Tolerant and Testable Computer Systems</td>
</tr>
</tbody>
</table>

**Description**
Technological reasons for faults, fault models, information redundancy, spatial redundancy, backward and forward error recovery, fault-tolerant hardware and software, modeling and analysis, testing, and design for test. Prerequisite: Electrical and Computer Engineering 250D or equivalent.

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<tr>
<td>ECE</td>
<td>555</td>
<td>Probability for Electrical and Computer Engineers</td>
</tr>
</tbody>
</table>

**Description**
Basic concepts and techniques used stochastic modeling of systems with applications to performance and reliability of computer and communications system. Elements of probability, random variables (discrete and continuous), expectation, conditional distributions, stochastic processes, discrete and continuous time Markov chains, introduction to queuing systems and networks. Prerequisite: Mathematics 216.

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<tr>
<td>ECE</td>
<td>556</td>
<td>Wireless Networking and Mobile Computing</td>
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</tbody>
</table>

**Description**
Theory, design, and implementation of mobile wireless networking systems. Fundamentals of wireless networking and key research challenges. Students review pertinent journal papers. Significant, semester-long research project. Networking protocols (Physical and MAC, multi-hop routing, wireless TCP, applications), mobility management, security, and sensor networking. Prerequisites: Electrical and Computer Engineering 356 or Computer Science 310.

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<tr>
<td>ECE</td>
<td>557</td>
<td>Performance and Reliability of Computer Networks</td>
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</table>

**Description**

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<tbody>
<tr>
<td>ECE</td>
<td></td>
<td>Advanced Computer Networks</td>
</tr>
</tbody>
</table>


Duke University

ECE559 - Advanced Digital System Design
Subject: ECE  
Catalog Number: 559  
Title: Advanced Digital System Design  
Description: Fundamentals of advanced digital system design, and the use of a hardware description language, VHDL, for their synthesis and simulation. System examples include the arithmetic/logic unit, memory, and microcontrollers. Team-based project incorporates engineering standards and realistic constraints, and also considers most of the following: Cost, environmental impact, manufacturability, health and safety, ethics, social and political impact. Prerequisite: [ECE 350L, 230L, 250D, 270DL, and 280L and (Mathematics 353 or 356) and (Statistical Science 130L or Statistical Science 240L or Mathematics 230 or Mathematics 340 or ECE 380 or ECE 555 or EGR 238L) and (Physics 152L or 26) and (Chemistry 101DL or 20 or 21) and ECE 331L (prerequisite or corequisite)] or graduate-student standing.

ECE560 - Computer and Information Security
Subject: ECE  
Catalog Number: 560  
Title: Computer and Information Security  
Description: An intense trip through many facets of computer and information security. Includes discussion and practical exercises in risk management, threat modeling, applied cryptography, malicious software, network security, intrusion detection and prevention, software and OS security, auditing and forensics, reverse engineering, and social engineering. Includes many hands-on security assignments. Prerequisite: Computer Science 310, ECE 353, or ECE 650.

ECE561 - Datacenter Architecture
Subject: ECE  
Catalog Number: 561  
Title: Datacenter Architecture  
Description: Ethical inquiry into journalism and its effect on public discourse. Issues include accuracy, transparency, conflicts of interest and fairness. Topics include coverage of national security, government secrecy, plagiarism/fabrication, and trade-offs of anonymous sourcing.

ECE562 - Energy-Efficient Computer Systems
Duke University

**ECE563 - Cloud Computing**

**Subject**
ECE

**Catalog Number**
563

**Title**
Cloud Computing

**Description**
In a seminar format, explore a number of the underlying technologies, business models, and innovations underpinning current widespread deployment of "cloud" computing systems, services, and applications. Each student will be expected to choose a relevant subject, identify appropriate advance readings for the class, and lead one discussion on topics of interest to the group. There will be a project component to the course; some projects may be in the form of literature reviews and papers, others will involve practical experience creating and deploying a useful service or application in a cloud environment.

**ECE564 - Mobile Application Development**

**Subject**
ECE

**Catalog Number**
564

**Title**
Mobile Application Development

**Description**
Explores the world of mobile application development with focus on needs of engineers. Centered on Apple environment, with the development environment being on OS X and the target environment being an iOS device - iPad, iPhone, iPod Touch or Apple Watch. Real world context focused on the common programming patterns for engineers in academia or business - standalone apps, apps connected to other systems, apps connected to the cloud. Covers fundamentals essential to understanding all aspects of app development. Taught in a team environment. Students required to present their project proposals and deliver an app as a final project. Prerequisite: CompSci 307D or CompSci 308 or ECE 651.

**ECE565 - Performance Optimization & Parallelism**

**Subject**
ECE

**Catalog Number**
565

**Title**
Performance Optimization & Parallelism

**Description**
Analyzing and optimizing the performance of software, in both a single- and multi-threaded setting. Apply knowledge of hardware, programming, and assembly to both tasks. Single-threaded performance topics include code profiling & analysis, loop transformation, analysis of interaction of code & memory hierarchy, assembly level instruction scheduling impacts. Multi-threaded topics include scalability & load balance. For students with strong foundation of programming skills in high-level languages, assembly language, and computer architecture & design. Prerequisite: [(ECE/CompSci 250D and (CompSci 310 or ECE 353)) or (ECE 550D and (ECE 551D or ECE 751D))] and ECE 552 (may be taken concurrently).

**ECE566 - Enterprise Storage Architecture**
Duke University

ECE567 - Cyber-Physical System Design

Subject  Catalog Number  Title
ECE  567  Cyber-Physical System Design

Description
Complex interactions between information technology and physical world in Cyber-Physical Systems (CPS) challenge standard design methods that ignore cross-cutting constraints. This course addresses CPS design challenges by exploiting theory and methods from embedded systems, controls, and formal methods. Course covers topics related to the integration of system modeling, analysis, and automatic synthesis into design frameworks that ensure closed-loop safety and performance under known and unknown operating conditions. Balances establishing a working knowledge of CPS design and analysis methods with understanding the theory behind them. Prerequisite: ECE 350L and Computer Science 310/ECE 353, or graduate-student standing.

ECE568 - Engineering Robust Server Software

Subject  Catalog Number  Title
ECE  568  Engineering Robust Server Software

Description
In this course, students learn about important principles in server software design and development. These principles include topics such as handling asynchronous behavior, design for failure, basic security principles, scalability, and resilience. Students will put these ideas into practices by developing software reflecting the ideas learned in class. Prerequisite: (ECE 551D or ECE 751D) and corequisite ECE 650, or [(Computer Science 307D or Computer Science 308) and (ECE 353 or CompSci 310) and (ECE 356 or CompSci 356)].

ECE571 - Electromagnetic Theory

Subject  Catalog Number  Title
ECE  571  Electromagnetic Theory

Description
The classical theory of Maxwell's equations; electrostatics, magnetostatics, boundary value problems including numerical solutions, currents and their interactions, and force and energy relations. Three class sessions. Prerequisite: Electrical and Computer Engineering 270DL.

ECE572 - Electromagnetic Communication Systems
### ECE 572 - Electromagnetic Communication Systems

**Description**

### ECE 573 - Optical Communication Systems

**Description**
Mathematical methods, physical ideas, and device concepts of optoelectronics. Maxwell's equations, and definitions of energy density and power flow. Transmission and reflection of plane waves at interfaces. Optical resonators, waveguides, fibers, and detectors are also presented. Prerequisite: Electrical and Computer Engineering 270DL or equivalent.

### ECE 574 - Waves in Matter

**Description**
Analysis of wave phenomena that occur in materials based on fundamental formulations for electromagnetic and elastic waves. Examples from these and other classes of waves are used to demonstrate general wave phenomena such as dispersion, anisotropy, and causality; phase, group, and energy propagation velocities and directions; propagation and excitation of surface waves; propagation in inhomogeneous media; and nonlinearity and instability. Applications that exploit these wave phenomena in general sensing applications are explored. Prerequisite: Electrical and Computer Engineering 270DL.

### ECE 575 - Microwave Electronic Circuits

**Description**
Microwave circuit analysis and design techniques. Properties of planar transmission lines for integrated circuits. Matrix and computer-aided methods for analysis and design of circuit components. Analysis and design of input, output, and interstage networks for microwave transistor amplifiers and oscillators. Topics on stability, noise, and signal distortion. Prerequisite: Electrical and Computer Engineering 270DL or equivalent.

### ECE 577 - Computational Electromagnetics

**Description**
Systematic discussion of useful numerical methods in computational electromagnetics including integral equation techniques and differential equation techniques, both in the frequency and time domains. Hands-on experience with numerical techniques, including the method of moments, finite element and finite-difference time-domain methods, and modern high order and spectral domain methods. Prerequisite: Electrical and Computer Engineering 571 or consent of instructor.
ECE578 - Inverse Problems in Electromagnetics and Acoustics

Subject: ECE
Catalog Number: 578
Title: Inverse Problems in Electromagnetics and Acoustics

Description
Systematic discussion of practical inverse problems in electromagnetics and acoustics. Hands-on experience with numerical solution of inverse problems, both linear and nonlinear in nature. Comprehensive study includes: discrete linear and nonlinear inverse methods, origin and solution of nonuniqueness, tomography, wave-equation based linear inverse methods, and nonlinear inverse scattering methods. Assignments are project oriented using MATLAB. Prerequisites: Graduate level acoustics or electromagnetics (Electrical and Computer Engineering 571), or consent of instructor.

ECE580 - Introduction to Machine Learning

Subject: ECE
Catalog Number: 580
Title: Introduction to Machine Learning

Description
Introduction to core concepts in machine learning and statistical pattern recognition, with a focus on discriminative and generative classifiers (nearest-neighbors, Bayes, logistic regression, linear discriminant, support vector machine, and relevance vector machine). Dimensionality reduction and feature selection. Classifier performance evaluation, bias-variance tradeoff, and cross-validation. Prerequisite: (Mathematics 216, 218D-1, 218D-2, or 221, or ECE 586) and (Computer Science 201 or ECE 551D) and (ECE 480 or ECE 581). Not open to students who have taken Computer Science 671D.

ECE580K - Introduction to Machine Learning

Subject: ECE
Catalog Number: 580K
Title: Introduction to Machine Learning

Description
Introduction to core concepts in machine learning and statistical pattern recognition, with a focus on discriminative and generative classifiers (nearest-neighbors, Bayes, logistic regression, linear discriminant, support vector machine, and relevance vector machine). Dimensionality reduction and feature selection. Classifier performance evaluation, bias-variance tradeoff, and cross-validation. Taught at Duke Kunshan University in Kunshan, China.

ECE581 - Random Signals and Noise

Subject: ECE
Catalog Number: 581
Title: Random Signals and Noise

Description
Introduction to mathematical methods of describing and analyzing random signals and noise. Review of basic probability theory, joint, conditional, and marginal distributions; random processes. Time and ensemble averages, correlation, and power spectra. Optimum linear smoothing and predicting filters. Introduction to optimum signal detection, parameter estimation, and statistical signal processing. Prerequisite: one of (STA 130L or STA 240L or Mathematics 230 or Mathematics 340 or ECE 380 or ECE 555 or EGR 238L) or graduate student standing.

ECE581K - Random Signals and Noise
### ECE581K - Random Signals and Noise

**Subject**: ECE  
**Catalog Number**: 581K  
**Title**: Random Signals and Noise  


### ECE582 - Digital Signal Processing

**Subject**: ECE  
**Catalog Number**: 582  
**Title**: Digital Signal Processing  

Introduction to fundamental algorithms used to process digital signals. Basic discrete time system theory, the discrete Fourier transform, the FFT algorithm, linear filtering using the FFT, linear production and the Wiener filter, adaptive filters and applications, the LMS algorithm and its convergence, recursive least-squares filters, nonparametric and parametric power spectrum estimation minimum variance and eigenanalysis algorithms for spectrum estimation. Prerequisite: Electrical and Computer Engineering 581 or equivalent with consent of the instructor.

### ECE585 - Signal Detection and Extraction Theory

**Subject**: ECE  
**Catalog Number**: 585  
**Title**: Signal Detection and Extraction Theory  

Introduction to signal detection and information extraction theory from a statistical decision theory viewpoint. Subject areas covered within the context of a digital environment are decision theory, detection and estimation of known and random signals in noise, estimation of parameters and adaptive recursive digital filtering, and decision processes with finite memory. Applications to problems in communication theory. Prerequisite: Electrical and Computer Engineering 581 or consent of instructor.

### ECE586 - Vector Space Methods with Applications

**Subject**: ECE  
**Catalog Number**: 586  
**Title**: Vector Space Methods with Applications  

Covers key concepts from advanced linear algebra that are used regularly in ECE/CS journal papers on signal processing, communications, circuit design, and machine learning (e.g., logic, topology, vector spaces, optimization). Key mathematical ideas/proofs will be presented and applied. Uses application topics such as Markov chains, alternating projections, and pattern classification to illustrate important mathematical topics. Background in linear algebra, a high-level programming language, and probability is assumed. Prerequisite: [(Mathematics 216, 221, or 218) and (Engineering 103L or Computer Science 201) and (STA 130 or STA 240L or Mathematics 230 or Mathematics 340 or ECE 380 or ECE 555 or EGR 238L) and ECE 280L] or graduate student standing.

### ECE586K - Vector Space Methods with Applications
Duke University

**ECE587 - Information Theory**

**Subject**
ECE

**Catalog Number**
587

**Title**
Information Theory

**Description**
Information theory is the science of processing, transmitting, storing, and using information. This course provides an introduction to mathematical measures of information and their connection to practical problems in communication, compression, and inference. Entropy, mutual information, lossless data compression, channel capacity, Gaussian channels, rate distortion theory, Fisher information. Useful for researchers in a variety of fields, including signal processing, machine learning, statistics, and neuroscience. Appropriate for beginning graduate students in electrical engineering, computer science, statistics, and math with a background in probability.

**ECE588 - Image and Video Processing: From Mars to Hollywood with a Stop at the Hospital**

**Subject**
ECE

**Catalog Number**
588

**Title**
Image and Video Processing: From Mars to Hollywood with a Stop at the Hospital

**Description**
Intro to image formation, image compression, image enhancement & image segmentation. Covers geometric and non-geometric tools, as well as spatial and non-spatial operations. Extension to color images and video. Addresses recent progress in the area, including image inpainting (how to remove objects from images and video), image processing via sparse modeling & compressed sensing, geometric partial differential equations for image analysis, image processing for HIV & virus research, image processing for neurosurgery & other medical applications. Prerequisite: [ECE 280L and (Mathematics 216, 218D-1, 218D-2, or 221) and (STA 130L or STA 240L or Mathematics 230 or Mathematics 340 or ECE 380 or ECE 555 or EGR 238L)] or graduate student standing.

**ECE590 - Advanced Topics in Electrical and Computer Engineering**

**Subject**
ECE

**Catalog Number**
590

**Title**
Advanced Topics in Electrical and Computer Engineering

**Description**
Opportunity for study of advanced subjects related to programs within the electrical and computer engineering department tailored to fit the requirements of a small group. Instructor consent required.
### ECE590D - Advanced Topics in Electrical and Computer Engineering

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE</td>
<td>590D</td>
<td>Advanced Topics in Electrical and Computer Engineering</td>
<td>Opportunity for study of advanced subjects related to programs within the electrical and computer engineering department tailored to fit the requirements of a small group. Has discussion.</td>
</tr>
</tbody>
</table>

### ECE590K - Advanced Topics in Electrical and Computer Engineering

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE</td>
<td>590K</td>
<td>Advanced Topics in Electrical and Computer Engineering</td>
<td>Opportunity for study of advanced subjects related to programs within the electrical and computer engineering department tailored to fit the requirements of a small group. Taught at Duke Kunshan University in Kunshan, China.</td>
</tr>
</tbody>
</table>

### ECE611 - Nanoscale and Molecular Scale Computing

<table>
<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE</td>
<td>611</td>
<td>Nanoscale and Molecular Scale Computing</td>
<td>Students study the design and analysis of nanoscale computing systems. Topics include nanoelectronic devices (e.g., graphene and carbon nanotube transistors, quantum dots, etc.), computational paradigms (conventional von Neumann, quantum cellular automata, quantum computing, etc.), microarchitecture and instruction set design specific to nanoscale systems, defect and fault tolerance, fabrication techniques (e.g., self-assembly), modeling and simulation methods. This course relies on current literature and student discussion. Prerequisites: Electrical and Computer Engineering 350, Electrical and Computer Engineering 511.</td>
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</tbody>
</table>

### ECE621 - Quantum Error Correction

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<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>ECE</td>
<td>621</td>
<td>Quantum Error Correction</td>
<td>In this course, we cover two related topics: quantum error correction and quantum computer architectures. In the beginning of the course, we will cover the basics of quantum error correction and develop the tools needed to understand modern methods of fault-tolerant quantum computation. In the end of the course, we will discuss how quantum error correction influences the design of a large-scale quantum computer. Prerequisite: ECE 523/PHYSICS 627 or ECE 420 or ECE 520.</td>
</tr>
</tbody>
</table>
### ECE623 - Quantum Information Theory

<table>
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<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>ECE</td>
<td>623</td>
<td>Quantum Information Theory</td>
</tr>
</tbody>
</table>

**Description**

This course introduces fundamental ideas of Quantum Information theory, such as entanglement, quantum entropy and mutual information, decoherence and quantum data compression. A primary goal of this field is to understand how quantum effects, such as entanglement, can enhance communication and cryptography protocols. Furthermore, the tools and ideas discussed in this course are essential for understanding and quantifying noise and decoherence in quantum computers. These concepts have also found various applications in different areas of Physics, including quantum thermodynamics, many-body systems and quantum gravity. Prerequisite: ECE 521, PHYSICS 464, ECE 586, MATH 216, MATH 221, or MATH 218.

### ECE631 - Analog and RF Integrated Circuit Design, Fabrication, and Test

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<tr>
<th>Subject</th>
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<th>Title</th>
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</thead>
<tbody>
<tr>
<td>ECE</td>
<td>631</td>
<td>Analog and RF Integrated Circuit Design, Fabrication, and Test</td>
</tr>
</tbody>
</table>

**Description**

For students who have some experience in analog circuit design and want to fabricate and test an IC under faculty supervision. Typically taken over three semesters (Fall, Spring, Summer, or Fall, Spring, Fall) to accommodate design-fabricate-test cycle. Design cycle: students use Cadence or Mentor IC layout tools, and HSPICE or ADS simulation tools. Fabrication cycle: a detailed test plan is developed. Test cycle: students access test facility appropriate for design and submit a report to the IC fabrication foundry. Co-requisite: ECE 539, or consent of instructor.

### ECE650 - Systems Programming and Engineering

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<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>ECE</td>
<td>650</td>
<td>Systems Programming and Engineering</td>
</tr>
</tbody>
</table>

**Description**

Focuses on a range of topics that are central to both the design of operating systems and the programming system-level software. Students will apply knowledge of basic concepts in operating systems, networking, and programming towards these two areas. Topics covered will include concurrency, process management, hypervisors, networking, security, databases, and file systems. Students will be expected to demonstrate their understanding in these areas through a series of programming assignments covering these topics. Prerequisite: ECE 550D and (ECE 551D or ECE 751D).

### ECE650K - Systems Programming and Engineering

<table>
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<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>ECE</td>
<td>650K</td>
<td>Systems Programming and Engineering</td>
</tr>
</tbody>
</table>

**Description**

Focuses on a range of topics that are central to both the design of operating systems and the programming system-level software. Students will apply knowledge of basic concepts in operating systems, networking, and programming towards these two areas. Topics covered will include concurrency, process management, hypervisors, networking, security, databases, and file systems. Students will be expected to demonstrate their understanding in these areas through a series of programming assignments covering these topics. Taught at Duke Kunshan University in Kunshan, China. Prerequisite: ECE 550K and ECE 551K.

### ECE651 - Software Engineering
ECE615K - Software Engineering

**Subject**  
ECE

**Catalog Number**  
651K

**Title**  
Software Engineering

**Description**  
Teaches students about all steps of the software development lifecycle: requirements definition, design, development, testing, and maintenance. The course assumes students are skilled object-oriented programmers from prior courses, but will include a rapid introduction to Java. Students complete team-based semester-long software project which will progress through all phases of the software lifecycle. Taught at Duke Kunshan University in Kunshan, China. Prerequisite: ECE 551K.

ECE622 - Advanced Computer Architecture II

**Subject**  
ECE

**Catalog Number**  
652

**Title**  
Advanced Computer Architecture II

**Description**  
Parallel computer architecture design and evaluation. Design topics include parallel programming, message passing, shared memory, cache coherence, memory consistency models, symmetric multiprocessors, distributed shared memory, interconnection networks, and synchronization. Evaluation topics include modeling, simulation, and benchmarking. Prerequisite: Computer Science 550 or Electrical and Computer Engineering 552 or consent of instructor.

ECE633 - Human-Centered Computing

**Subject**  
ECE

**Catalog Number**  
653

**Title**  
Human-Centered Computing

**Description**  
This course addresses the importance of the human-computer interface in the design and development of things that people use. Many of the perceptual, cognitive, and social characteristics of people, as well as methods for learning more about the people, are covered. The capabilities and limits of computers and other related systems are discussed as they relate to the impact on design and implementation decisions. The course consists of a semester-long project that steps through the various stages of design. This semester’s project will be reimaging on campus mental health management. Prerequisite: Computer Science 307D or 308 or Electrical and Computer Engineering 651.

ECE644 - Edge Computing
ECE654 - Edge Computing

**Description**
A seminar-format examination of design principles and recent advances in edge computing, a distributed networked system architecture that places computing and storage at multiple locations between the user and the cloud. The class covers edge computing platforms, edge-adapted algorithms, and the use of edge in mobile and Internet of Things systems and applications. The class focuses on in-depth examinations of key scientific advances in the field. Students complete and present a research-based project, individual or team-based. Prerequisite: ECE/COMPSCI 356 or ECE/COMPSCI 350L or ECE 353/COMPSCI 310 or Graduate Standing.

ECE661 - Computer Engineering Machine Learning and Deep Neural Nets

**Description**
This course examines various computer engineering methods commonly performed in developing machine learning and deep neural network models. The focus of the course is on how to improve the training and inference performance in terms of model accuracy, size, runtime, etc. Techniques that are widely investigated and adopted in industrial companies and academic communities will be discussed and practiced. Programming practices on these techniques are designed with heavy utilization of the PyTorch package. Prerequisites: Computer Science 201 or ECE 551D or ECE 751D.

ECE662 - Machine Learning Acceleration and Neuromorphic Computing

**Description**
The rapidly growing size of neural networks adopted in modern artificial intelligence (AI) applications makes accelerating computations of machine learning algorithms a critical need of the industry. This course will introduce various approaches to design high-efficient neural network models and to include hardware constraints in the efficient neural network designs. We will also discuss the hardware techniques that can accelerate the computations of neural networks on different computing platforms such as GPU, FPGA, and ASIC. Bio-inspired computing and neuromorphic computing will be also discussed. The course is a mix of lectures, labs, & projects. Prerequisite: ECE 250D/COMPSCI 250D, or ECE 552/COMPSCI 550, or permission of instructor.

ECE675 - Optical Imaging and Spectroscopy

**Description**

ECE676 - Lens Design
Duke University

ECE681 - Pattern Classification and Recognition Technology

Subject: ECE
Catalog Number: 676
Title: Lens Design

Description: Paraxial and computational ray tracing. Merit functions. Wave and chromatic aberrations. Lenses in photography, microscopy and telescope. Spectrograph design. Emerging trends in lens system design, including multiple aperture and catadioptric designs and nonimaging design for solar energy collection. Design project management. Each student must propose and complete a design study, including a written project report and a formal design review. Prerequisite: Electrical and Computer Engineering 340L or 375.

ECE681 - Pattern Classification and Recognition Technology

Subject: ECE
Catalog Number: 681
Title: Pattern Classification and Recognition Technology

Description: Theory and practice of recognition technology: pattern classification, pattern recognition, automatic computer decision-making algorithms. Applications covered include medical diseases, severe weather, industrial parts, biometrics, bioinformation, animal behavior patterns, image processing, and human visual systems. Perception as an integral component of intelligent systems. This course prepares students for advanced study of data fusion, data mining, knowledge base construction, problem-solving methodologies of “intelligent agents” and the design of intelligent control systems. Prerequisites: Mathematics 216, Statistical Science 130 or Mathematics 230, Computer Science 101, or consent of instructor.

ECE682D - Probabilistic Machine Learning

Subject: ECE
Catalog Number: 682D
Title: Probabilistic Machine Learning

Description: Introduction to concepts in probabilistic machine learning with a focus on discriminative and hierarchical generative models. Topics include directed and undirected graphical models, kernel methods, exact and approximate parameter estimation methods, and structure learning. Prerequisite: Linear algebra, Statistical Science 250 or Statistical Science 611.

ECE683 - Digital Communication Systems

Subject: ECE
Catalog Number: 683
Title: Digital Communication Systems

Description: Digital modulation techniques. Coding theory. Transmission over bandwidth constrained channels. Signal fading and multipath effects. Spread spectrum. Optical transmission techniques. Prerequisite: Electrical and Computer Engineering 581 or consent of instructor.

ECE684 - Natural Language Processing
Natural Language Processing

Introduction to algorithmic and analytic methods specific to textual data. Subject areas covered are speech recognition, optical character recognition, text parsing, and document analysis. Analysis tools taught include sentiment analysis/topic models, auto-correct, auto-complete, and translation systems. Applications to brain-computer interface communication systems, intelligent personal assistants, and plagiarism detection systems. Prerequisite: STA 130L, STA 240L, Mathematics 230, Mathematics 340, ECE 380, ECE 555, ECE 580, ECE 581, ECE 682D, EGR 238L, or ECE 551D.

Introduction to Deep Learning

Provides an introduction to the machine learning technique called deep learning or deep neural networks. A focus will be the mathematical formulations of deep networks and an explanation of how these networks can be structured and “learned” from big data. Discussion section covers practical applications, programming, and modern implementation practices. Example code and assignments will be given in Python with heavy utilization of PyTorch (or Tensorflow) package. The course and a project will cover various applications including image classification, text analysis, object detection, etc. Prerequisite: ECE 580, ECE 681, ECE 682D, Statistical Science 561D, or Computer Science 571D.

Introduction to Deep Learning

Provides an introduction to the machine learning technique called deep learning or deep neural networks. A focus will be the mathematical formulations of deep networks and an explanation of how these networks can be structured and “learned” from big data. Discussion section covers practical applications, programming, and modern implementation practices. Example code and assignments will be given in Python with heavy utilization of PyTorch (or Tensorflow) package. The course and a project will cover various applications including image classification, text analysis, object detection, etc. Prerequisite: ECE 580K.

Adaptive Filters

Adaptive digital signal processing with emphasis on the theory and design of finite-impulse response adaptive filters. Stationary discrete-time stochastic processes, Wiener filter theory, the method of steepest descent, adaptive transverse filters using gradient-vector estimation, analysis of the LMS algorithm, least-squares methods, recursive least squares and least squares lattice adaptive filters. Application examples in noise canceling, channel equalization, and array processing. Prerequisites: Electrical and Computer Engineering 581 and 582 or consent of instructor.

Theory and Algorithms for Machine Learning
### ECE687D - Theory and Algorithms for Machine Learning

**Description**

This is an introductory overview course at an advanced level. Covers standard techniques, such as the perceptron algorithm, decision trees, random forests, boosting, support vector machines and reproducing kernel Hilbert spaces, regression, K-means, Gaussian mixture models and EM, neural networks, and multi-armed bandits. Covers introductory statistical learning theory. Recommended prerequisite: linear algebra, probability, analysis or equivalent.

### ECE688 - Sensor Array Signal Processing

**Description**

An in-depth treatment of the fundamental concepts, theory, and practice of sensor array processing of signals carried by propagating waves. Topics include: multidimensional frequency-domain representations of space-time signals and linear systems; apertures and sampling of space-time signals; beamforming and filtering in the space-time and frequency domains, discrete random fields; adaptive beamforming methods; high resolution spatial spectral estimation; optimal detection, estimation, and performance bounds for sensor arrays; wave propagation models used in sensor array processing; blind beamforming and source separation methods; multiple-input-multiple-output (MIMO) array processing; application examples from radar, sonar, and communications systems.

### ECE721 - Nanotechnology Materials Lab

**Description**

This course provides an introduction to advanced methods for the characterization and fabrication of materials, nanostructures, and devices. Cleanroom methods to be covered include lithography, evaporation, and etching. Characterization methods include electron microscopy, atomic force microscopy, X-ray photoelectron spectroscopy, and optical spectroscopy. Students will receive an overview of the techniques in the Shared Materials Instrumentation Facility through lectures and demonstrations. In the lab section, each student will engage in a project that focuses on those capabilities that are needed for their research, and will receive training and certification on that equipment.

### ECE722 - Quantum Electronics

**Description**

Quantum theory of light-matter interaction. Laser physics (electron oscillator model, rate equations, gain, lasing condition, oscillation dynamics, modulation) and nonlinear optics (electro-optic effect, second harmonic generation, phase matching, optical parametric oscillation and amplification, third-order nonlinearity, optical bistability.) Prerequisite Electrical and Computer Engineering 521, Physics 464, or equivalent.
ECE751D - Advanced Programming, Data Structures, and Algorithms in C++

Subject  | Catalog Number | Title                                      
----------|----------------|--------------------------------------------
ECE       | 751D           | Advanced Programming, Data Structures, and Algorithms in C++

Description
Students learn C++, data structures (linked lists, balanced BSTs, hash tables, graphs), Abstract Data Types (Stacks, Queues, Maps, Sets), & algorithms (sorting, graph search, minimal spanning tree). Efficiency of such structures & algorithms compared via Big-O analysis. Students learn multi-threaded programming. Emphasis on defensive coding, and use of standard UNIX development tools in preparation for students' entry into real world software development jobs. Strong C programming skills required to enroll. Those without such skills should take Electrical and Computer Engineering 551D instead. Instructor consent required. Not open to students who have taken or are currently taking Electrical and Computer Engineering 551D.

ECE781 - Advanced Topics in Signal Processing

Subject  | Catalog Number | Title                                      
----------|----------------|--------------------------------------------
ECE       | 781            | Advanced Topics in Signal Processing

ECE784LA - Sound in the Sea: Introduction to Marine Bioacoustics

Subject  | Catalog Number | Title                                      
----------|----------------|--------------------------------------------
ECE       | 784LA          | Sound in the Sea: Introduction to Marine Bioacoustics

Description
Fundamentals marine bioacoustics with focus on current literature and conservation issues. Topics include: intro acoustics; acoustic analysis methods and quantitative tools; production/recording of sound; ocean noise; propagation theory; active/passive acoustics; hearing, sound production and communication in marine organisms, potential impacts of anthropogenic noise; and regulation of marine sound. Lab focus on methodologies for generating, recording and analyzing marine sounds. Grad students responsible for additional acoustic analyses and results prep for student projects plus preparation additional lit review/critique. Taught in Beaufort at Duke Marine Lab. Prerequisite: AP or introductory biology or consent; Physics 41L or 161L (or equivalent) or consent.

ECE891 - Internship
Student gains practical electrical and computer engineering experience by taking a job in industry and writing a report about this experience. May be repeated with consent of the advisor and the director of graduate studies. A full-time internship is available to ECE graduate students if it allows them to gain practical experience in a work environment related to their academic training and enhances their overall academic experience and, for students on F-1 Visa, their employment prospects once they return to their home country. Requires prior consent from the student's advisor and from the director of graduate studies. Credit/no credit grading only.

Special individual readings in a specified area of study in electrical engineering. Approval of director of graduate studies required.

Designed for graduate engineering students who are non-native English speakers. Gain the skills necessary to confidently navigate the use of oral English. Learn social and academic norms needed for academic success and build interactional competence. Learn to deliver a self-introduction, brief overview of research/degree program/professional experience, and navigate small talk and social interactions through the development of cultural contexts and an understanding of conversational mechanics. Build the skills needed to actively participate in classes, seek help from multiple sources, and navigate productive interactions with faculty. Open only to Pratt graduate students.

This writing course is designed for graduate engineering students who are non-native English speakers. The focus will be on writing and revising such that the results are clear and concise. Students will produce a variety of academic and professional documents pertinent to engineers. Additionally, students will analyze the written work of peers and provide relevant feedback. Open only to Pratt graduate students.

Subjects of an interdepartmental nature in engineering tailored to the advanced undergraduate student or first- or second-year graduate student. Instructor consent is required. Half course or one course.
EGR590-1 - Special Topics in Engineering

Subject  Catalog Number  Title
EGR  590-1  Special Topics in Engineering

Description
Subjects of an interdepartmental nature in engineering tailored for entry-level graduate students.

EGR705 - Academic English Presentations for Engineers

Subject  Catalog Number  Title
EGR  705  Academic English Presentations for Engineers

Description
Course designed for graduate engineering students who are non-native English speakers. Gain the skills necessary to deliver successful engineering-specific presentations. Through feedback, you will learn your strengths and weaknesses and will develop as a successful speaker. Practice delivering both short-form presentations and longer form formal presentations, as required by your particular field of study in engineering. Where possible, presentation practice in class will be related to your engineering course work.

EGR706 - Intermediate English Writing for Engineers

Subject  Catalog Number  Title
EGR  706  Intermediate English Writing for Engineers

Description
This writing course is designed for graduate engineering students who are non-native English speakers. The focus will be on writing and revising that result in clear, effective and concise products. Students will produce a variety of academic and professional documents pertinent to engineers. Additionally, students will analyze the written work of their peers and provide them with relevant feedback.

EGR790 - Special Topics in Engineering

Subject  Catalog Number  Title
EGR  790  Special Topics in Engineering

Description
General engineering topics intended for graduate students only, and interdepartmental in nature. Instructor consent is required. Quarter course, half course, or one course.

EGR790-1 - Special Topics in Engineering

Subject  Catalog Number  Title
EGR  790-1  Special Topics in Engineering

Description
Subjects at an intermediate or advanced level in engineering that are interdepartmental in nature. Courses tailored to graduate students that have the introductory knowledge required. Variable Credit.

EGR790S - Special Topics in Engineering for Graduate Students
**EGRMGMT501 - Engineering Management Seminar**

**Subject**  
EGRMGMT

**Catalog Number**  
501

**Title**  
Engineering Management Seminar

**Description**
Current topics in applied engineering management and entrepreneurship. Weekly seminar series. Credit/No credit.

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**EGRMGMT504 - Residency 1 - Introduction**

**Subject**  
EGRMGMT

**Catalog Number**  
504

**Title**  
Residency 1 - Introduction

**Description**
One-week course to introduce the Master of Engineering Management Program. Residency 1 includes an orientation to Duke and the program, business simulations, case studies, professional development workshops and alumni engagement opportunities. Prerequisite: enrollment in the Master of Engineering Management Online Program.

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**EGRMGMT505 - Residency 2 - Mid-Program**

**Subject**  
EGRMGMT

**Catalog Number**  
505

**Title**  
Residency 2 - Mid-Program

**Description**
One-week course to assess interim progress for the Master of Engineering Management Online Program. Residency 2 includes team-building exercises, case studies, leadership training, workshops, seminars and engagement opportunities. Prerequisite: EGRMGMT 504.

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**EGRMGMT506 - Residency 3 - Conclusion and Graduation**

**Subject**  
EGRMGMT

**Catalog Number**  
506

**Title**  
Residency 3 - Conclusion and Graduation

**Description**
One-week course to conclude the Master of Engineering Management Online Program. Residency 3 includes internship presentations, team-building exercises, case studies, leadership training, professional development workshops, exit interviews, and graduation activities. Prerequisite: EGRMGMT 505.

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**EGRMGMT510 - Marketing**
### Duke University

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<tbody>
<tr>
<td>EGRMGMT</td>
<td>510</td>
<td>Marketing</td>
</tr>
</tbody>
</table>

**Description**
Review basic concepts in marketing; marketing of high tech products and services. Product development with short life cycles, selling into complex supply chains, building advantage through innovation, the role of the customer in high tech and technology-intensive service industries, and marketing in volatile environments. Prerequisite: enrollment in the Master of Engineering Management Program.

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<tr>
<td>EGRMGMT</td>
<td>512</td>
<td>Product Management in High-Tech Companies</td>
</tr>
</tbody>
</table>

**Description**
Students will explore the entire product management challenge in a way that goes beyond the typical MBA product marketing and brand management course with emphasis on managing products & services in a high tech environment. The course provides an in-depth exposure to the analyses, decisions, and implementation issues relevant to a typical product manager in a high tech company and prepares students for their first industry product management opportunity. This course is the first step in developing the set of skills needed for a successful product manager utilizing a mix of individual and team-based assignments, case analysis and presentations, computer simulations and projects.

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<th>Subject</th>
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<tbody>
<tr>
<td>EGRMGMT</td>
<td>513</td>
<td>Product Development</td>
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</table>

**Description**
This course aims to build students’ understanding about the product or service development process and the factors influencing its execution. The transformation of an innovative idea into a product or service involves several phases — discovery, definition, development, demonstration, qualification, deployment and life cycle management — as well as balancing the external factors that impact these phases, depending on the unique product or service. Adequate management of these factors enables the development process to be executed on time and on budget while meeting customer needs and stakeholder expectations.

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<tbody>
<tr>
<td>EGRMGMT</td>
<td>514</td>
<td>Negotiations and Consultative Selling in Technology</td>
</tr>
</tbody>
</table>

**Description**
Skills in negotiations and consultative selling are required. From making a decision that affects internal operations, presenting a proposal to one’s boss, or closing a sale with a major client, it is vital to have a strong set of skills to achieve our objectives. Focusing on two primary areas of influence and communication within business—negotiations and consultative selling (working collaboratively with others to effectively meet customer needs), this course covers the structured processes, theoretical constructs, and practical applications required to understand a complex situation and develop the negotiation or sales process most needed for value creation and goal attainment.

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<tr>
<td>EGRMGMT</td>
<td>520</td>
<td>Intellectual Property, Business Law, and Entrepreneurship</td>
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136 / 161
Duke University

Subject EGRMGMT
Catalog Number 520
Title Intellectual Property, Business Law, and Entrepreneurship

Description
Basic principles of intellectual property law, especially patent law but including trademark and copyright law, together with an overview of business law and the formation of new technical enterprises. Consideration of regulatory law, contract law, and product liability. Licensing and the use of the patent database in technological development. Prerequisite: enrollment in the Master of Engineering Management Program.

EGRMGMT530 - Finance in High Tech Industries

Subject EGRMGMT
Catalog Number 530
Title Finance in High Tech Industries

Description
Review basic concepts of financial accounting and finance, with an emphasis on accounting needed for effective financial analysis. Focus on issues of finance in high tech industries. Emphases will include project financing, notions of options as applied to internal financial analysis, allocation of costs and revenues for new high tech projects, valuing projects and valuing firms when intellectual assets are a significant portion of total level value; corporate control in high tech firms. Finance issues in mergers, acquisitions, and alliances. Prerequisite: enrollment in the Master of Engineering Management Program.

EGRMGMT532 - Advanced Corporate Finance for Technology-Based Companies

Subject EGRMGMT
Catalog Number 532
Title Advanced Corporate Finance for Technology-Based Companies

Description
The focus of this course will be on major financial decisions of established technology corporations as well as entrepreneurial ventures. Analytical models and theories will be covered via problems and cases. Specific areas will include asset management, short-term and long-term borrowing, advanced capital budgeting strategies, determination of capital structure, dividend policy, international issues, and mergers and other forms of restructuring. Prerequisite: enrollment in the Master of Engineering Management Program.

EGRMGMT534 - Quantitative Financial Analysis for Technology-Driven Investment Decisions

Subject EGRMGMT
Catalog Number 534
Title Quantitative Financial Analysis for Technology-Driven Investment Decisions

Description
In this introductory quantitative finance course, students will learn to build practical financial models using MS Excel spreadsheets. Investment banks, hedge funds, and money managers make buy and sell decisions based on computational models. This course starts with the most basic, and most important, portfolio and investment models used to evaluate risk and identify profit opportunities. Using Excel, students will learn how to build these models themselves, and to understand the decision-making inputs used by professional investors. The course’s practical focus utilizes today’s computationally sophisticated tools to analyze stock prices, bonds, options, and other financial instruments.
### EGRMGMT540 - Management of High Tech Industries

**Subject** | **Catalog Number** | **Title**  
--- | --- | ---  
EGRMGMT | 540 | Management of High Tech Industries  

**Description**
The purpose of this course is to empower students to become collaborative, ethical leaders in the globalized, 21st-century workplace. Students learn concepts and practice skills that will enable them to transition from being an engineering sole contributor to managing and leading others as a business professional. Students gain a sound understanding of management and leadership; increase awareness of their own management and leadership styles; build and practice competencies essential for team success (e.g., effective communication, collaboration, conflict resolution); and become ethical leaders above reproach. Emphasis is on leading teams in a volatile, complex and interdependent world.

### EGRMGMT542 - Competitive Strategy in Technology-Based Industries

**Subject** | **Catalog Number** | **Title**  
--- | --- | ---  
EGRMGMT | 542 | Competitive Strategy in Technology-Based Industries  

**Description**
This course is designed to teach the elements of competitive strategy with a focus on the special considerations of technology-based companies, with particular emphasis on innovation and entrepreneurial activities in ventures of all sizes. Students will gain an appreciation for the strategic considerations that affect the success of technology-based products in the marketplace through a systematic exposure to key concepts in analysis, formulation and execution of strategic options. The course is structured along the lines that a company or organization would likely follow in the development of a competitive strategy.

### EGRMGMT550 - Engineering Management Internship

**Subject** | **Catalog Number** | **Title**  
--- | --- | ---  
EGRMGMT | 550 | Engineering Management Internship  

**Description**
A three-credit internship which requires participation with a cooperating organization, whether local or distant, involving a well-defined set of tasks. Full-time employment in an appropriate capacity may be utilized for this internship. This course is a required co or prerequisite for Engineering Management 551. Prerequisite: Enrollment in the Master of Engineering Management Program.

### EGRMGMT551 - Engineering Management Internship Assessment

**Subject** | **Catalog Number** | **Title**  
--- | --- | ---  
EGRMGMT | 551 | Engineering Management Internship Assessment  

**Description**
This course involves the assessment of a student's internship experience via a report and oral presentation. The questions and general format of the report and presentation will be provided by the instructor. The report and presentation will be evaluated by the instructor and both must be approved to obtain credit for this course. Students must have completed or be simultaneously enrolled in Engineering Management 550 which is a course designated for the internship experience. Prerequisite: Enrollment in the Master of Engineering Management Program.

### EGRMGMT556 - Engineering Management Practicum
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<tbody>
<tr>
<td>EGRMGMT</td>
<td>556</td>
<td>Engineering Management Practicum</td>
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</table>

**Description**
The Engineering Management Practicum provides a real life view of various challenges faced by organizations. Projects at the intersection of engineering and business will be chosen for this practicum. Students will work in teams and will conduct a mentored, semester-long project for an organization. The learning objectives of this course include: (i) learn how engineering and technology impact organizations and how they are integrated into an organization to achieve desired results; (ii) understand, through an experiential environment, how organizations function and the difference between theory and implementation in an organizational setting; and (iii) develop team based skills in an applied environment and learn how to communicate technical issues to a variety of personnel in an organization. Consent of instructor required.

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<tr>
<td>EGRMGMT</td>
<td>560</td>
<td>Project Management</td>
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**Description**
Projects are one of the key mechanisms for achieving organizational goals and implementing change, whether it is the design and launch of a new product, the construction of a new building, or the development of a new information system. This course will focus on defining project scope, developing project plans, managing project execution, validating project performance and ensuring project control. Additional topics covered include decision making, project finance, project portfolio selection and risk management.

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<tr>
<td>EGRMGMT</td>
<td>562</td>
<td>Operations Management</td>
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**Description**
Operations management involves planning and controlling the processes used to produce the goods and services provided by an organization. In essence, it is the management of all activities related to doing the actual work of the organization. Managing these processes can be quite challenging - they are often very complex, and can involve large numbers of people and facilities, huge volumes of materials and great distance. Objectives of the course are to: i) Introduce students to the functional area of operations and to increase their awareness of how a firm's operations interface with the other functional areas of the organization, ii) Familiarize students with the various issues and problems that traditionally arise in the management of operations within both manufacturing and service organizations, iii) Acquaint students with some of the terminology, modeling, and methodologies that often arise in the handling and resolution of operations issues and problem.

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<tr>
<td>EGRMGMT</td>
<td>563</td>
<td>Supply Chain Management</td>
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**Description**
The objectives of this course are to develop conceptual and modeling skills for the student and provide practical problem-solving tools, applicable to the design and analysis of supply chains. Students will also identify how the existence of multiple (distinct) decision makers in the supply chain can create misaligned incentives that harm supply chain performance and then learn how to mitigate this problem. Examples will include technology supply chains, and supply chains for innovative products. The course will balance modeling/quantitative problem solving with conceptual frameworks. Prerequisite: Enrollment in the Master of Engineering Management Program or permission of instructor.
EGRMGMT572 - Innovation Management in Technology-Based Organizations

**Subject**
EGRMGMT

**Catalog Number**
572

**Title**
Innovation Management in Technology-Based Organizations

**Description**
This course takes students through a variety of issues related to managing innovation in the context of a technology-based organization. This includes managing know-how and innovation processes as well as creating an organizational culture that fosters and supports innovation. Students study best practices and benchmarks but must develop their own approach to managing innovation given each unique situation, including the organizational strategy, the competitive landscape, the strengths/weaknesses of the employees involved, etc. Nonetheless, there are accepted practices and concepts that will help guide students in developing a deeper understanding of this area.

EGRMGMT574 - Commercializing Technology Innovations: Turning Visions into Value

**Subject**
EGRMGMT

**Catalog Number**
574

**Title**
Commercializing Technology Innovations: Turning Visions into Value

**Description**
This course is designed to demystify and unify the journey from idea creation to value extraction through the use of concrete tools and real-world exercise. Innovations have many sources (e.g., individuals, companies, universities, governments) and many vehicles for commercialization (e.g., licensing, new products, enhanced products, and new ventures). Through this course, students will learn to think more broadly about innovation and commercialization options and strategies. Prerequisite: enrollment in the Master of Engineering Management Program.

EGRMGMT575 - Software Quality Management

**Subject**
EGRMGMT

**Catalog Number**
575

**Title**
Software Quality Management

**Description**
This class is designed to help students understand what it takes to build software products and services that meet customer quality expectations from day one. It introduces students to five different business personas that play a key role in the software life cycle: customer, software engineer, software release/quality manager, customer support engineer, and general manager. For each of these players, it reviews what they do and what is most critical to quality. The class also provides exposure to current industry practices, case studies, data analysis and guest speakers who can describe "what a day in the life" of each of these personas looks like.

EGRMGMT576 - Design Thinking and Innovation

**Subject**
EGRMGMT

**Catalog Number**
576

**Title**
Design Thinking and Innovation

**Description**
Success of established companies and entrepreneurial ventures depends on their ability to identify customer needs and develop products and services to meet these needs effectively. A disciplined design thinking process leads to successful innovations, particularly with regard to value creation and market impact. Starting with an understanding of empathy, ethnography, and interviewing, moving on to the iterative process of defining, ideating, prototyping, and testing, and then developing final designs, this course allows students to develop a deep set of skills in design thinking and innovation and includes current approaches such as agile development, biodesign, and lean startup.
EGRMGMT578 - Designing Customer Experiences in Technology

Subject: EGRMGMT  
Catalog Number: 578  
Title: Designing Customer Experiences in Technology

Description: Increasingly, the quality of a business’s "user experience" offerings provide the key to securing loyal customer relationships and sustainable market differentiation. Students are introduced to foundational design techniques and use case study discussions, readings, and hands-on projects to form a framework and "personal toolkit" for designing compelling customer experiences. In addition, students flesh out this framework through project-based assignments and presentations applying the principles of design thinking, human factors, design for usability, and interaction design to analyze, create, and present effective customer experience solutions.

EGRMGMT579 - Using Real-Time Data to Improve Customer Quality Experience

Subject: EGRMGMT  
Catalog Number: 579  
Title: Using Real-Time Data to Improve Customer Quality Experience

Description: This class is designed to help students understand what it takes to improve customer experience using data. Emphasis is placed on the collection and use of real-time data for transforming customer experience. Key topics covered include the customer experience life cycle, data management and types, data collection infrastructure, use of metrics to create insights, using python for data science, creation of machine learning algorithms to predict customer impacting events and using data to support the customer success business model. Finally, the class provides exposure to current industry practices, case studies, a comprehensive final project and industry guest speakers.

EGRMGMT580 - Decision Models

Subject: EGRMGMT  
Catalog Number: 580  
Title: Decision Models

Description: Problems involving uncertainty and/or complex interactions can be too difficult to grasp intuitively. This course introduces spreadsheet modeling, simulation, decision analysis and optimization to represent and analyze such complex problems. First, the use of decision trees for structuring decision problems under uncertainty is discussed. Next, Monte Carlo simulation is used as a modeling environment, using add-in programs as necessary. Prerequisite: Familiarity with Excel, enrollment in the Master of Engineering Management program, or permission of instructor.

EGRMGMT585 - Fundamentals of Data Science in Engineering Management

Subject: EGRMGMT  
Catalog Number: 585  
Title: Fundamentals of Data Science in Engineering Management

Description: In this course, students will learn the fundamentals of data science, including core technical vocabulary and mathematical concepts. This will include topics such as (i) probability through Bayesian techniques; (ii) binary classification; (iii) linear regression for forecasting; (iv) information measures used in data science, including mutual information, relative entropy (KL divergence), and log loss (cross entropy), (v) Experimental design; and (vi) the roles of training and test data, using Hoeffding’s inequality to forecast error rates. Students will apply the above concepts to real-world data, while developing their own models for probabilistic forecasting.
EGRMGMT586 - New Opportunities in Big Data
Subject: EGRMGMT  
Catalog Number: 586  
Title: New Opportunities in Big Data  
Description: This course prepares students for transitioning to industry data science practitioners by focusing on learning-by-doing. Students gain hands-on experience applying statistical and machine learning techniques using real world data and creating data science solutions through Python and other popular open source tools in the era of big data. In addition, the course covers lectures on a number of intermediate data science topics such as supervised learning, unsupervised learning, ensemble learning, model optimization, text analytics, and data visualization. Recommended prerequisite: at least one undergraduate level statistics course and prior programming experience (not necessarily in Python).

EGRMGMT587 - Data Visualization for Engineering Managers
Subject: EGRMGMT  
Catalog Number: 587  
Title: Data Visualization for Engineering Managers  
Description: Students learn best practices for presenting discoveries and “calls to action” that are the primary aims of business data analysis. Learning about human visual perception, in particular the science of how choice of color, form, and other design elements can assist pre-attentive information processing. Origins of modern data-visualization in the pre-computer age are considered, starting with the use of overlay maps, and Galton’s Quincunx and Correlation Diagram. Students learn to recognize the most commonly utilized types of data-visualization metaphor, as well as rules of thumb for various types of data analysis. No prior software experience required.

EGRMGMT588 - Machine Learning Principles and Applications for Engineering Managers
Subject: EGRMGMT  
Catalog Number: 588  
Title: Machine Learning Principles and Applications for Engineering Managers  
Description: This course focuses on understanding how machine learning (ML) works and case studies of its successful application to a wide range of problem types, from better forecasting customer behavior, to playing Go, to responding appropriately to human speech. Students will learn the basic mathematical principles behind establishing reliable ML performance, and have an opportunity to experiment with various ML algorithms and observe how they perform on real-world data. The course does not require any prior programming experience. Recommended prerequisite: an introductory data science course.

EGRMGMT590 - Advanced Topics in Engineering Management
Subject: EGRMGMT  
Catalog Number: 590  
Title: Advanced Topics in Engineering Management  
Description: Opportunity for study of advanced subjects related to programs within engineering management tailored to fit the requirements of a small group. Permission of instructor required.

EGRMGMT590L - Advanced Topics in Engineering Management (with Lab)
EGRMGMT 591 - Special Readings in Engineering Management

Subject: EGRMGMT
Catalog Number: 591
Title: Special Readings in Engineering Management

Description
Individual readings in advanced study and research areas of engineering management. Consent of instructor required.

ENRGYEGR 531 - Power Electronic Circuits for Energy Conversion

Subject: ENRGYEGR
Catalog Number: 531
Title: Power Electronic Circuits for Energy Conversion

Description
Efficient conversion of electrical energy is critical for electric and hybrid vehicles, wind and solar energy, power grids, computers, medical devices, and portables. This course teaches analysis and design of power electronic circuits for energy conversion, including circuit operation (converter topologies, steady-state modeling, switch realization), converter control (ac modeling, small-signal transfer functions, feedback), and magnetics (inductors, transformers). The course shares lectures with ECE/Energy Engineering 431, but has extended assignments. Prerequisite: ECE 230L or Engineering 224L or graduate student standing. Not open to students who have taken ECE 431 or Energy Engineering 431.

ENRGYEGR 590 - Special Topics in Energy Engineering

Subject: ENRGYEGR
Catalog Number: 590
Title: Special Topics in Energy Engineering

Description
Study arranged on a special topic in which the instructor has particular interest and competence. Topics vary by section.

FINTECH 501 - Financial Technology Seminar

Subject: FINTECH
Catalog Number: 501
Title: Financial Technology Seminar

Description
Current topics in applied financial technology and entrepreneurship. Weekly seminar series. Credit/No credit.

FINTECH 502 - FinTech Capstone
This course is a culmination of the FinTech program and will focus on developing solutions to a real world problem. For example, sufficient retirement income is an increasingly pressing problem in the United States and most developed countries given growth in retirement age, health care cost and quality, with corresponding longevity of the population. In order to obtain solutions that are economically and operationally feasible there is a need to understand, through forecasting techniques, the probable outcomes, with an eye towards both sides of the balance sheet. This will ensure that solutions created do not operate in a vacuum that fails to account for global economic environment.

**FINTECH504 - Introductory Residency**

**Description**
One-week course to introduce the Master of Engineering FinTech Online Program. Residency 1 includes an orientation to Duke and the program, business simulations, case studies, professional development workshops and alumni engagement opportunities. Open only to students in the Master of Engineering FinTech Online Program.

**FINTECH505 - Mid-Program Residency**

**Description**
One-week course to assess interim progress for the Master of Engineering FinTech Online Program. Residency 2 includes team-building exercises, case studies, leadership training, workshops, seminars and engagement opportunities. Prerequisite: FINTECH 504. Open only to students in the Master of Engineering FinTech Online Program.

**FINTECH506 - Concluding Residency**

**Description**
One-week course to conclude the Master of Engineering FinTech Online Program. Residency 3 includes internship presentations, team-building exercises, case studies, leadership training, professional development workshops, and exit interviews. Prerequisite: FINTECH 505. Open only to students in the Master of Engineering FinTech Online Program.

**FINTECH510 - Programming for FinTech**

**Description**
This class is aimed at students who want to focus on financial technology (FinTech) but who may not have a programming or even technical background. This course will bring students up to speed on programming, data structures, and algorithms. C++ is the language of choice in this class because C and C++ are very commonly used by computer engineers.
FINTECH512 - Software Engineering for FinTech

Subject: FINTECH
Catalog Number: 512
Title: Software Engineering for FinTech

Description:
This course focuses on moving from small-to-medium software projects, to the design ideas required for larger scale, maintainable code. We will start with core design principles, which we will see manifest in a variety of the forms through the course of the semester. We will see these ideas emerge from smaller scale design at the start of the semester to large scale system architecture at the end. Testing will also be an important topic throughout.

FINTECH514 - Secure Software Development

Subject: FINTECH
Catalog Number: 514
Title: Secure Software Development

Description:
This course is about minimizing risk when creating software and will focus on the fundamental structure of a Secure Development Life Cycle (SDLC), the advantages and challenges of cryptography, then explore automated testing solutions. Students will learn to effectively manage risk in the process of creating software. Hands-on experience with specific technologies prepare students to make informed decisions about the design, architecture, and implementation of software. Assignments use automated vulnerability hunting tools. Students will learn the risk profile of the target software project, and an understanding of how these tools add value to the overall secure development life cycle.

FINTECH520 - Financial Institution Products & Services

Subject: FINTECH
Catalog Number: 520
Title: Financial Institution Products & Services

Description:
The course will provide students with an understanding of finance and financial concepts, with emphasis on innovation and technological changes. Study includes the maturation of products and services used by financial services firms, the monetary and financial system, the structural position of institutions comprising the financial services industry and their businesses, and “non-banks”. Students will acquire skills to develop interest rate forecasting models, asset management methodologies, and time value of money applications. A review of the role of industry vendors/utilities will complete an understanding of this environment.

FINTECH522 - Asset Pricing and Risk Management

Subject: FINTECH
Catalog Number: 522
Title: Asset Pricing and Risk Management

Description:
Much of financial valuation is based on the trade-off between returns (i.e., profit) and risk (i.e., volatility of returns). This core understanding of the correlation between return and risk permeates all areas of finance from banking to brokerage to investment management. The primary purpose of Asset Liability Management within banking is to ensure that the bank is sufficiently capitalized to provide a cushion for risk exposure, while continuing to enable growth and profitability. In this course, students will learn about various financial, macroeconomic, business, and technology risks, as well as the tools and methodologies for quantitative assessment of risk and performance.

FINTECH533 - Design and Testing of Algorithmic Trading Systems
FINTECH534 - Quantitative Financial Analysis for Technology-Driven Investment Decisions

Description
This course introduces students to the tools, concepts, and workflow used by industry to craft algorithmic trading systems, as well as the financial concepts involved. Using the Python Dash framework, students will build simple but powerful trading apps that fetch data, pass trade orders, and evaluate performance metrics. Students will gain exposure to modern Python data analytics packages, GitHub Actions, market data feeds, web scraping, and trade execution system APIs. The course assumes an entry-level understanding of Python and finance and is intended for students who wish to take their skills to the next level.

FINTECH534 - Quantitative Financial Analysis for Technology-Driven Investment Decisions

Description
An introduction to the most important concepts used in quantitative finance. Students will learn to build practical financial models using MS Excel spreadsheets. This course starts with the most basic, and most important, portfolio and investment models used to evaluate risk and identify profit opportunities. Using Excel, students will learn how to build these models themselves, and to understand the decision-making inputs used by professional investors. The course has a practical focus—how to analyze prices of stocks, bonds, options and other financial instruments using the types of computationally sophisticated tools in wide use today.

FINTECH535 - Advanced Design and Testing of Algorithmic Trading Systems

Description
This course is intended for students who are already comfortable with Python Dash, have some knowledge of finance, trading, and market data, and wish to take a deep dive into the development and evaluation of one trading strategy. Forming teams of 2 to 4, students will produce a Python trading app which implements the team’s strategy to process incoming data into actionable trade orders, pass the orders to a professional execution system, and visualize results and performance metrics as a dynamic web page. At the end of the semester, each team will present their strategy and results to Duke faculty and industry professionals at the annual Alpha Summit event. Prerequisite: Financial Technology 533.

FINTECH536 - Robo-Advising: The Future of Investing?

Description
Robo-Advice brings investment services to a wider audience at lower costs compared to human advisors. Students will construct a very basic advisor using the Python programming language. This will be a short experiential case study with an open source Python code. Student teams will develop a comprehensive venture capital investment memorandum for a real-world Robo-Advising startup. Teams will analyze the Robo-Advisor’s market environment, including the financial services industry, wealth management segments, competitors and channels; and, internal company characteristics, such as business strategy, asset allocation and portfolio composition, cost of customer acquisition, and financials.
**FINTECH540 - Machine Learning for FinTech**

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<tbody>
<tr>
<td>FINTECH</td>
<td>540</td>
<td>Machine Learning for FinTech</td>
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**Description**

Explores the history, current environment, and near-term outlook of Machine Learning, focusing on the applications within financial innovation (FinTech). The course provides hands on experience in applying machine learning tools in a number of situations, as well as understanding the applications across finance. This class will delve into elements of the current environment of Fintech and how machine learning has contributed to the disruption. The goal of this course is that students leave with not only knowledge but hands on experience implementing machine learning to solve problems and observe how this tool works and where the present and future value may be.

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**FINTECH545 - Quantitative Risk Management**

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<tr>
<td>FINTECH</td>
<td>545</td>
<td>Quantitative Risk Management</td>
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**Description**

Quantitative Risk Management offers a hands-on introduction to the science and implementation of risk analytics. Topics include probability theory, regression and time series analysis, risk metrics such as Value at Risk and Expected Shortfall, derivative valuation methods, stress testing and scenario analysis, factor models, and portfolio construction and optimization.

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**FINTECH550 - Emerging Trends for FinTech**

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<tr>
<td>FINTECH</td>
<td>550</td>
<td>Emerging Trends for FinTech</td>
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**Description**

This class will study the environment of FinTech services to understand and acquire assessment techniques to model the motivation behind, for example: individual companies and offerings, the technology that has enabled many of these companies, and the business models that frequently challenge the customer service status quo. Applications of Game Theory—the ways in which businesses compete in the financial marketplace—will provide significant insights into the strategic behavior of current and future FinTech companies. The ever-increasing pace at which technology disrupts long standing business models will be reviewed in terms of both past, current, and possible future applications.

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**FINTECH552 - FinTech Business Models**

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<tr>
<td>FINTECH</td>
<td>552</td>
<td>FinTech Business Models</td>
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</table>

**Description**

The goal of this course is for students to understand the business models in the major FinTech value chain segments (businesses include, but are not limited to, marketplace lending, neo-banking, robo-advisory, crypto currency and other blockchain applications). In this course, we analyze the business models of selected FinTech companies with a special focus on the role of data. In some industries, such as banking, data has spurred and supported the new business models of the FinTechs. Therefore, data is most relevant for creating an overview of the actors in the FinTech, and broader financial services, ecosystem.

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**FINTECH564 - Blockchain**
## FINTECH564 - Blockchain

**Subject**: FINTECH  
**Catalog Number**: 564  
**Title**: Blockchain

**Description**
Blockchain technology is being embraced in finance and other industries as an encryption base for all types of applications. This course explores the history, current environment, and near-term outlook of financial innovation (FinTech), focusing on applications of Blockchain technology. Topics range from digital stores of value to documents and transactions. Students will learn to formulate an accurate image and deep practical understanding of the capabilities and limitations of various blockchain techniques. Students will gain hands-on experience creating a simple Blockchain contract and will be able to converse on a practical basis about what Blockchain can and cannot do.

## FINTECH565 - Advanced Blockchain - Smart Contacts and Solidity Coding

**Subject**: FINTECH  
**Catalog Number**: 565  
**Title**: Advanced Blockchain - Smart Contacts and Solidity Coding

**Description**
This course follows the basic blockchain course to provide students hands-on experience and instruction in Solidity coding via a number of exercises and programming assignments. These provide a basis from which students will be introduced to the details of smart contracts and the application of the coding skills acquired to develop and deploy these programs. Deployment will be primarily via public blockchains using developer functions. Prerequisite: Financial Technology 564.

## FINTECH590 - Advanced Topics in Financial Technology

**Subject**: FINTECH  
**Catalog Number**: 590  
**Title**: Advanced Topics in Financial Technology

**Description**
Opportunity for study of advanced subjects related to programs within financial technology tailored to fit the requirements of a small group. Permission of instructor required.

## FINTECH590L - Advanced Topics in Financial Technology (with Lab)

**Subject**: FINTECH  
**Catalog Number**: 590L  
**Title**: Advanced Topics in Financial Technology (with Lab)

**Description**
Opportunity for study of advanced subjects with laboratory related to programs within financial technology tailored to fit the requirements of a small group. Consent of instructor required.

## FINTECH591 - Special Readings in Financial Technology

**Subject**: FINTECH  
**Catalog Number**: 591  
**Title**: Special Readings in Financial Technology

**Description**
Individual readings in advanced study and research areas of financial technology. Consent of instructor required.
ME510 - Diffraction and Spectrometry of Materials

Subject  | Catalog Number  | Title
---|---|---
ME  | 510  | Diffraction and Spectrometry of Materials

Description
This course focuses on the fundamentals and applications of x-ray/neutron/electron scattering for the study of materials, with an emphasis on crystalline solids. The class will cover topics in diffraction for the study of the atomic structure of materials, as well as spectrometry to investigate microscopic dynamics and composition. The students should have a background in solid state physics/chemistry, quantum mechanics, materials science, and mathematics including Fourier transforms and complex numbers, convolution product. Open to graduate students; instructor consent required for undergraduate students to enroll.

ME511 - Computational Materials Science

Subject  | Catalog Number  | Title
---|---|---
ME  | 511  | Computational Materials Science

Description
This course will cover modern computational techniques for the prediction of materials properties, beginning from the scale of electrons and atoms and connecting to materials challenges in experiments today. Subjects covered will include Schroedinger’s equation and density functional theory, molecular dynamics, and so-called multiscale approaches to connect quantities computed at the nanoscale to macroscopic properties. The class will incorporate specific examples as explicit computer exercises. The course is expected to provide an atomic-scale understanding of materials for both students with a primarily computational interest and those students whose research is primarily experimental. Open to graduate students; instructor consent required for undergraduate students to enroll.

ME513 - Nanobiomechanics

Subject  | Catalog Number  | Title
---|---|---
ME  | 513  | Nanobiomechanics

Description
The course consists of didactic lectures and many laboratory demonstrations and real experiments done by the students themselves. Topics include: Principles of single-molecule force spectroscopy (SMFS), SMFS experimental techniques, resolution and resolution limitations; Entropic and enthalpic elasticity of (bio)polymers; Structure and nanomechanics of DNA, polysaccharides, and proteins; Mechanisms of spontaneous folding, misfolding and refolding of proteins; Chaperones-assisted protein refolding; Principles of computer modeling of biopolymer mechanics; Development and characterization of novel, protein-based nanostructured, rationally designed biomaterials with unique mechanical properties. Open to graduate students; instructor consent required for undergraduate students to enroll.

ME514 - Theoretical and Applied Polymer Science (GE, BB)

Subject  | Catalog Number  | Title
---|---|---
ME  | 514  | Theoretical and Applied Polymer Science (GE, BB)

Description
An intermediate course in soft condensed matter physics dealing with the structure and properties of polymers and biopolymers. Introduction to polymer syntheses based on chemical reaction kinetics, polymer characterization. Emphasizes (bio)polymers on surfaces and interfaces in aqueous environments, interactions of (bio)polymer surfaces, including wetting and adhesion phenomena.
**ME516 - Thin-Film Photovoltaic Technology**

**Description**

This course will focus on a promising class of solar cells based on thin-film absorbers, some of which are already commercialized (e.g., CdTe, CIGS), while others are on the cutting edge of new photovoltaics technology (e.g., perovskites). The course will employ a combination of lecture, directed reading and hands-on approaches. The hands-on component of the course will involve fabricating PV devices and employing contemporary characterization and modeling tools to evaluate device performance. Specific techniques and the intellectual framework are more generally applicable to other PV and electronic devices. Recommended prerequisite: ECE 230 or related familiarity with electronic properties of materials. Open to graduate students; instructor consent required for undergraduate students to enroll.

**ME517 - Electromagnetic Processes in Fluids**

**Description**

Electromagnetic processes and transport phenomena in fluids is overviewed. Topics to be discussed include: Maxwell's equations, statistical thermodynamic processes, origin of surface forces (i.e. Van der Waals), plasma in gases and electrolyte distribution, wave propagation near boundaries and in complex media, transport equations in continuum limit. Consent of instructor required.

**ME524 - Introduction to the Finite Element Method**

**Description**

Investigation of the finite element method as a numerical technique for solving linear ordinary and partial differential equations, using rod and beam theory, heat conduction, elastostatics and dynamics, and advective/diffusive transport as sample systems. Emphasis placed on formulation and programming of finite element models, along with critical evaluation of results. Topics include: Galerkin and weighted residual approaches, virtual work principles, discretization, element design and evaluation, mixed formulations, and transient analysis. Prerequisites: a working knowledge of ordinary and partial differential equations, numerical methods, and programming in FORTRAN or MATLAB.

**ME525 - Nonlinear Finite Element Analysis**

**Description**

Formulation and solution of nonlinear initial/boundary value problems using the finite element method. Systems include nonlinear heat conduction/diffusion, geometrically nonlinear solid and structural mechanics applications, and materially nonlinear systems (for example, elastoplasticity). Emphasis on development of variational principles for nonlinear problems, finite element discretization, and equation-solving strategies for discrete nonlinear equation systems. Topics include: Newton-Raphson techniques, quasi-Newton iteration schemes, solution of nonlinear transient problems, and treatment of constraints in a nonlinear framework. An independent project, proposed by the student, is required. Prerequisite: Civil and Environmental Engineering 530/Mechanical Engineering 524, or consent of instructor.
**ME527 - Buckling of Engineering Structures**

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<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>ME</td>
<td>527</td>
<td>Buckling of Engineering Structures</td>
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</tbody>
</table>

**Description**

An introduction to the underlying concepts of elastic stability and buckling, development of differential equation and energy approaches, buckling of common engineering components including link models, struts, frames, plates, and shells. Consideration will also be given to inelastic behavior, postbuckling, and design implications.

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**ME531 - Engineering Thermodynamics**

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<thead>
<tr>
<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
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<tbody>
<tr>
<td>ME</td>
<td>531</td>
<td>Engineering Thermodynamics</td>
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</tbody>
</table>

**Description**


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**ME532 - Convective Heat Transfer**

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<th>Subject</th>
<th>Catalog Number</th>
<th>Title</th>
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<tbody>
<tr>
<td>ME</td>
<td>532</td>
<td>Convective Heat Transfer</td>
</tr>
</tbody>
</table>

**Description**

Models and equations for fluid motion, the general energy equation, and transport properties. Exact, approximate, and boundary layer solutions for laminar flow heat transfer problems. Use of the principle of similarity and analogy in the solution of turbulent flow heat transfer. Two-phase flow, nucleation, boiling, and condensation heat and mass transfer.

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**ME535 - Biomedical Microsystems**

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<th>Subject</th>
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<th>Title</th>
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<tbody>
<tr>
<td>ME</td>
<td>535</td>
<td>Biomedical Microsystems</td>
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</table>

**Description**

The objective of the course is to introduce students to the interdisciplinary field of biomedical microsystems with an emphasis on biomedical microelectromechanical systems (bioMEMS) and microtechnologies. Topics include Scaling laws, Micropatterning of substrates and cells, Microfluidics, Molecular biology on a chip, Cell-based chips for biotechnology, BioMEMS for cell biology, Tissue microengineering, and Microfabricated implants and sensors. Open to graduate students; instructor consent required for undergraduate students to enroll.

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**ME536 - Compressible Fluid Flow**

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<tbody>
<tr>
<td>ME</td>
<td>536</td>
<td>Compressible Fluid Flow</td>
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</tbody>
</table>

**Description**

Basic concepts of the flow of gases from the subsonic to the hypersonic regime. One-dimensional wave motion, the acoustic equations, and waves of finite amplitude. Effects of area change, friction, heat transfer, and shock on one-dimensional flow. Moving and oblique shock waves and Prandtl-Meyer expansion. Prerequisite: Mechanical Engineering 336L or equivalent.
### ME538 - Physicochemical Hydrodynamics

**Subject**  
ME  
**Catalog Number**  
538  
**Title**  
Physicochemical Hydrodynamics  

**Description**  
An introduction to the fundamental principles of physicochemical hydrodynamics with an emphasis on the coupling between transport processes and interfacial phenomena. Topics include Brownian motion and molecular diffusion, electrokinetics and electrohydrodynamics, capillary and wetting. Through homework sets and a course project, the students will develop physical intuition and scaling tools to single out the dominant physicochemical process in a complex system. Prerequisite: Mechanical Engineering 336L or consent of instructor.

### ME539 - Interfacial Transport Phenomena for Energy Technologies

**Subject**  
ME  
**Catalog Number**  
539  
**Title**  
Interfacial Transport Phenomena for Energy Technologies  

**Description**  
The main topics are transport phenomena taking place on interfaces in renewable/sustainable energy technology. These transport phenomena comprise of charge transport (ions, electrons), heat transfer, and mass transfer (e.g. diffusion), sometimes coupled with chemical reactions (e.g. catalytic, electrochemical, photochemical). We will study these transport phenomena at interfaces, especially in the micro- and nano-scale and apply this knowledge to energy conversion and storage processes. These interfacial transport phenomena are essential for photovoltaic cells, fuel cells, batteries, solar thermal devices, thermoelectric devices, and many others. Open to graduate students; instructor consent required for undergraduate students to enroll. Recommended prerequisite: Mechanical Engineering 431 or equivalent.

### ME541 - Intermediate Dynamics: Dynamics of Very High Dimensional Systems

**Subject**  
ME  
**Catalog Number**  
541  
**Title**  
Intermediate Dynamics: Dynamics of Very High Dimensional Systems  

**Description**  

### ME543 - Energy Flow and Wave Propagation in Elastic Solids

**Subject**  
ME  
**Catalog Number**  
543  
**Title**  
Energy Flow and Wave Propagation in Elastic Solids  

**Description**  
Derivation of equations for wave motion in simple structural shapes: strings, longitudinal rods, beams and membranes, plates and shells. Solution techniques, analysis of systems behavior. Topics covered include: nondispersive and dispersive waves, multiple wave types (dilational, distortion), group velocity, impedance concepts including driving point impedances and moment impedances. Power and energy for different cases of wave propagation. Prerequisites: Engineering 244L and Mathematics 353 or consent of instructor.
### ME544 - Advanced Mechanical Vibrations

**Subject:** ME  
**Catalog Number:** 544  
**Title:** Advanced Mechanical Vibrations  

**Description:** Advanced mechanical vibrations are studied primarily with emphasis on application of analytical and computational methods to machine design and vibration control problems. Equations of motion are developed using Lagrange's equations. A single degree-of-freedom system is used to determine free vibration characteristics and response to impulse, harmonic periodic excitations, and random. The study of two and three degree-of-freedom systems includes the determination of the eigenvalues and eigenvectors, and an in-depth study of modal analysis methods. The finite element method is used to conduct basic vibration analysis of systems with a large number of degrees of freedom. The student learns how to balance rotating machines, and how to design suspension systems, isolation systems, vibration sensors, and tuned vibration absorbers.

### ME555 - Advanced Topics in Mechanical Engineering

**Subject:** ME  
**Catalog Number:** 555  
**Title:** Advanced Topics in Mechanical Engineering  

**Description:** Opportunity for study of advanced subjects related to programs within mechanical engineering tailored to fit the requirements of a small group. Approval of director of undergraduate or graduate studies required.

### ME560S - Materials Science and Engineering Seminar

**Subject:** ME  
**Catalog Number:** 560S  
**Title:** Materials Science and Engineering Seminar  

**Description:** This course is a seminar class open to all students with an interest in Materials Science & Engineering (MS&E) at Duke University. For the graduate students in the Duke University Program in MS&E (Masters and Ph.D. tracks), this seminar course is a mandatory component. The course generally consists of four external seminars (with Q&A opportunities for all interested students after the seminar) and of eight “internal” meeting periods with presentations by Duke graduate students. Each internal seminar course session will generally feature one “journal” presentation and one “original research” presentation, designed for twenty minutes presentation time plus discussion.

### ME562 - Materials Synthesis and Processing

**Subject:** ME  
**Catalog Number:** 562  
**Title:** Materials Synthesis and Processing  

**Description:** Materials form the basis of most modern technologies, whether referring to energy, data processing, medical/health or consumer product application. While materials properties are central to the application, the techniques used for processing functional materials into films, crystals or bulk form, with carefully tailored properties, is no less important and will form the basis of the class. Additionally, the course will expose students to current materials processing/application research thrusts at Duke.

### ME571 - Aerodynamics
ME572 - Engineering Acoustics

**Subject**: ME  
**Catalog Number**: 572  
**Title**: Engineering Acoustics

**Description**
Fundamentals of acoustics including sound generation, propagation, reflection, absorption, and scattering. Emphasis on basic principles and analytical methods in the description of wave motion and the characterization of sound fields. Applications including topics from noise control, sound reproduction, architectural acoustics, and aerodynamic noise. Occasional classroom or laboratory demonstration. This course is open only to undergraduate seniors and graduate students. Prerequisites: Mathematics 353 or equivalent or consent of instructor.

ME581 - Introduction to Scientific Computing

**Subject**: ME  
**Catalog Number**: 581  
**Title**: Introduction to Scientific Computing

**Description**
Topics include: Discrete representation of floating-point numbers; integration of ODEs and systems of DEs; classification and numeric solution of PDEs; accuracy, consistency, and stability; integration and spectral representation of functions; introduction to finite difference, finite volume, and finite element methods; roots of equations; elements of linear algebra and conjugate gradient methods for sparse linear systems; programming methods; graphical user interfaces; arrays and collections; input-output and serialization; generics and lambda expressions; object-oriented programming; 2D and 3D computer graphics; threading and parallelization; unit testing; third party numeric libraries. Open to graduate students; instructor consent required for undergraduate students to enroll.

ME582 - Applications in Data and Materials Science

**Subject**: ME  
**Catalog Number**: 582  
**Title**: Applications in Data and Materials Science

**Description**
AI principles will be applied to a series of materials science example problems, each taught in a module by an expert in materials science or data science. Each module will span 2-3 weeks, demonstrating an array of data science/AI methods in unique materials case studies in advancing discovery or design principles. Prerequisites: ME 221 or equivalent, introductory machine learning course.

ME591 - Research Independent Study in Mechanical Engineering or Material Science
ME592 - Research Independent Study in Mechanical Engineering or Material Science

Description
Research project mentored by an instructor with related interests and expertise. The project is expected to be graduate-level work. Instructor consent required.

ME593 - Research Independent Study in Mechanical Engineering or Material Science

Description
Research project mentored by an instructor with related interests and expertise. The project is expected to be graduate-level work. Instructor consent required.

ME594 - Research Independent Study in Mechanical Engineering or Material Science

Description
Research project mentored by an instructor with related interests and expertise. The project is expected to be graduate-level work. Instructor consent required.

ME627 - Linear System Theory
Subject            | Catalog Number | Title                          
-------------------|----------------|-------------------------------
ME                 | 627            | Linear System Theory          

**Description**

Construction of continuous and discrete-time state space models for engineering systems, and linearization of nonlinear models. Applications of linear operator theory to system analysis. Dynamics of continuous and discrete-time linear state space systems, including time-varying systems. Lyapunov stability theory. Realization theory, including notion of controllability and observability, canonical forms, minimal realizations, and balanced realizations. Design of linear feedback controllers and dynamic observers, featuring both pole placement and linear quadratic techniques. Introduction to stochastic control and filtering. Prerequisites: Electrical and Computer Engineering 382 or Mechanical Engineering 344, or consent of instructor.

**ME631 - Intermediate Fluid Mechanics**

Subject            | Catalog Number | Title                          
-------------------|----------------|-------------------------------
ME                 | 631            | Intermediate Fluid Mechanics  

**Description**

A survey of the principal concepts and equations of fluid mechanics, fluid statics, surface tension, the Eulerian and Lagrangian description, kinematics, Reynolds transport theorem, the differential and integral equations of motion, constitutive equations for a Newtonian fluid, the Navier-Stokes equations, and boundary conditions on velocity and stress at material interfaces.

**ME632 - Advanced Fluid Mechanics**

Subject            | Catalog Number | Title                          
-------------------|----------------|-------------------------------
ME                 | 632            | Advanced Fluid Mechanics      

**Description**

Flow of a uniform incompressible viscous fluid. Exact solutions to the Navier-Stokes equation. Similarity methods. Irrotational flow theory and its applications. Elements of boundary layer theory. Prerequisite: Mechanical Engineering 631 or consent of instructor.

**ME634 - Turbulence 1**

Subject            | Catalog Number | Title                          
-------------------|----------------|-------------------------------
ME                 | 634            | Turbulence 1                   

**Description**

This is an introductory course on the subject of turbulence in fluids. The focus is on understanding the fundamental physical processes and mechanisms governing the behavior of turbulent flows. The course covers the following: overview of physical and mathematical properties of Navier-Stokes equation; kinematics, dynamics and energetics of turbulent flows; Kolmogorov theories of turbulence; Richardson energy cascade; wall-bounded turbulent flows; particle dispersion, clustering and collisions in turbulent flows. Prerequisite: (CEE 301L or ME 336L) and Mathematics 353) or graduate standing. Recommended prerequisite: an introductory course on fluid mechanics, and a course on differential equations.

**ME639 - Computational Fluid Mechanics and Heat Transfer**
Description
An exposition of numerical techniques commonly used for the solution of partial differential equations encountered in engineering physics. Finite-difference schemes (which are well-suited for fluid mechanics problems); notions of accuracy, conservation, consistency, stability, and convergence. Recent applications of weighted residuals methods (Galerkin), finite-element methods, and grid generation techniques. Through specific examples, the student is guided to construct and assess the performance of the numerical scheme selected for the particular type of transport equation (parabolic, elliptic, or hyperbolic).

ME671 - Advanced Aerodynamics

Subject  Catalog Number  Title
ME       671           Advanced Aerodynamics

Description

ME672 - Unsteady Aerodynamics

Subject  Catalog Number  Title
ME       672           Unsteady Aerodynamics

Description
Analytical and numerical methods for computing the unsteady aerodynamic behavior of airfoils and wings. Small disturbance approximation to the full potential equation. Unsteady vortex dynamics. Kelvin impulse and apparent mass concepts applied to unsteady flows. Two-dimensional unsteady thin airfoil theory. Time domain and frequency domain analyses of unsteady flows. Three-dimensional unsteady wing theory. Introduction to unsteady aerodynamic behavior of turbomachinery. Prerequisite: Mechanical Engineering 571.

ME674 - Fundamentals of Shock Wave Lithotripsy

Subject  Catalog Number  Title
ME       674           Fundamentals of Shock Wave Lithotripsy

Description
This course will cover fundamental physics and engineering topics in shock wave lithotripsy (SWL), a non-invasive medical treatment of kidney and upper urinary tract stone disease. A historical review of the development of SWL will be provided. Shock wave generation, focusing, coupling, and propagation in biological tissues will be discussed, as well as state-of-the-art measurement techniques for characterization of lithotripter field and shock wave-stone-tissue interaction. Methodology and technologies to enhance therapeutic gain while reducing collateral tissue injury will be discussed, with laboratory projects to develop the basic concepts and essential skills for independent research. Prerequisite: Mechanical Engineering 336L, Mechanical Engineering 572, or BME 542.

ME676 - Advanced Acoustics
**ME701 - Capillarity & Wetting**

**Subject**  
ME

**Catalog Number**  
701

**Title**  
Capillarity & Wetting

**Description**  
Opportunity for study of advanced subjects related to programs within mechanical engineering tailored to fit the requirements of a small group. Approval of director of undergraduate or graduate studies required.

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**ME702 - Constructal Thermal Design**

**Subject**  
ME

**Catalog Number**  
702

**Title**  
Constructal Thermal Design

**Description**  
Elements of thermal design, thermodynamic optimization. The constructal law projects. The generation and pursuit of flow configurations that perform better.

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**ME711 - Nanotechnology Materials Lab**

**Subject**  
ME

**Catalog Number**  
711

**Title**  
Nanotechnology Materials Lab

**Description**  
This course provides an introduction to advanced methods for the characterization and fabrication of materials, nanostructures, and devices. Cleanroom methods to be covered include lithography, evaporation, and etching. Characterization methods include electron microscopy, atomic force microscopy, X-ray photoelectron spectroscopy, and optical spectroscopy. Students will receive an overview of the techniques in the Shared Materials Instrumentation Facility through lectures and demonstrations. In the lab section, each student will engage in a project that focuses on those capabilities that are needed for their research, and will receive training and certification on that equipment.

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**ME717S - Biological Engineering Seminar Series (CBIMMS and CBTE)**
ME718S - Biological Engineering Seminar Series (CBIMMS and CBTE)

Subject: ME  
Catalog Number: 718S  
Title: Biological Engineering Seminar Series (CBIMMS and CBTE)

Description
Seminar series featuring in alternate weeks invited speakers and pre-seminar discussions. Research topics in biological engineering, with emphasis on bioinspired materials and materials systems, biomolecular, and tissue engineering. Enrollment is required of all BIMMS and BTE certificate program students in their first and second year. Open to others for credit or audit. Instructor consent required.

ME742 - Nonlinear Mechanical Vibration

Subject: ME  
Catalog Number: 742  
Title: Nonlinear Mechanical Vibration

Description
A comprehensive treatment of the role of nonlinearities in engineering dynamics and vibration. Analytical, numerical, and experimental techniques are developed within a geometrical framework. Prerequisite: Mechanical Engineering 541 or 544 or equivalent.

ME758S - Curricular Practical Training

Subject: ME  
Catalog Number: 758S  
Title: Curricular Practical Training

Description
Curricular Practical Training. Student gains practical Mechanical Engineering and Materials Science experience by taking a job in industry and writing a report about this experience. Course requires prior consent from the student's advisor and from the Director of Graduate Studies and may be repeated with consent of the advisor and the Director of Graduate Studies.

ME759 - Special Readings in Mechanical Engineering

Subject: ME  
Catalog Number: 759  
Title: Special Readings in Mechanical Engineering

Description
Individual readings in advanced study and research areas of mechanical engineering. Approval of director of graduate studies required. 1 to 3 units.
ME775 - Aeroelasticity

Subject: ME  
Catalog Number: 775  
Title: Aeroelasticity

Description: A study of the statics and dynamics of fluid/structural interaction. Topics covered include static aeroelasticity (divergence, control surface reversal), dynamic aeroelasticity (flutter, gust response), unsteady aerodynamics (subsonic, supersonic, and transonic flow), and a review of the recent literature including nonlinear effects such as chaotic oscillations. Prerequisite: Mathematics 230 and consent of instructor.

ME789 - Internship in Mechanical Engineering

Subject: ME  
Catalog Number: 789  
Title: Internship in Mechanical Engineering

Description: Student gains practical mechanical engineering experience by taking a job in industry, and writing a report about this experience. Requires prior consent from the student's advisor and from the director of graduate studies. May be replaced with consent of the advisor and the director of graduate studies. Credit/no credit grading only.

MENG540 - Management of High Tech Industries

Subject: MENG  
Catalog Number: 540  
Title: Management of High Tech Industries

Description: The purpose of this course is to empower students to become collaborative, ethical leaders in the globalized, 21st-century workplace. Students learn concepts and practice skills that will enable them to transition from being an engineering sole contributor to managing and leading others as a business professional. Students gain a sound understanding of management and leadership; increase awareness of their own management and leadership styles; build and practice competencies essential for team success (e.g., effective communication, collaboration, conflict resolution); and become ethical leaders above reproach. Emphasis is on leading teams in a volatile, complex and interdependent world.

MENG550 - Master of Engineering Internship/Project

Subject: MENG  
Catalog Number: 550  
Title: Master of Engineering Internship/Project

Description: Students gain practical engineering experience by participating in an internship of project involving a well-defined set of tasks or objectives. Prerequisite: enrollment in the Master of Engineering Program or faculty permission.

MENG550K - Master of Engineering Internship/Project

Subject: MENG  
Catalog Number: 550K  
Title: Master of Engineering Internship/Project

Description: Students gain practical engineering experience by participating in an internship of project involving a well-defined set of tasks or objectives. Prerequisite: enrollment in the Master of Engineering Program or faculty permission. Taught at Duke Kunshan University in Kunshan, China.
MENG551 - Master of Engineering Internship/Project Assessment

Subject: MENG  
Catalog Number: 551  
Title: Master of Engineering Internship/Project Assessment

Description
Students will prepare a substantive assessment of their internship or project experience via a written report and/or oral presentation. Pre- or co-requisite: Completion of an internship or project. Prerequisite: enrollment in the Master of Engineering Program or faculty permission.

MENG570 - Business Fundamentals for Engineers

Subject: MENG  
Catalog Number: 570  
Title: Business Fundamentals for Engineers

Description
This comprehensive course examines core and evolving concepts in the business fundamentals of successful technology-based companies including Business Plan Development & Strategies, Marketing, Product & Process Development processes, Intellectual Property, Accounting, Finance, and Operations. Students will learn the fundamentals essential to understanding all aspects of a business and will be able to converse in some depth in each of the areas studied upon completion. Other topics will include Supply Chain Management, Stage-Gate Development Cycles, Balances Scorecards, Blue Ocean Strategy, and Disruptive Technologies.

NANOSCI511 - Foundations of Nanoscale Science and Technology

Subject: NANOSCI  
Catalog Number: 511  
Title: Foundations of Nanoscale Science and Technology

Description
This course is the introductory course for the Graduate Certificate Program in Nanoscience (GPNANO) and is designed to introduce students to the interdisciplinary aspects of nanoscience by integrating important components of the broad research field together. This integrated approach will cross the traditional disciplines of biology, chemistry, electrical & computer engineering, computer science, and physics. Fundamental properties of materials at the nanoscale, synthesis of nanoparticles, characterization tools, and self-assembly. Prerequisites: Physics 152L and Chemistry 101DL or instructor approval.

REG702 - Engineering Professional Study Away

Subject: REG  
Catalog Number: 702  
Title: Engineering Professional Study Away

Description
Engineering Professional Study Away