Department of Mechanical Engineering

The Department of Mechanical Engineering (MechE) embodies MIT's motto, *mens et manus*, "mind and hand," while also bringing "heart" into the equation. We combine analysis and hands-on discovery with a commitment to making the world a better place, and train new generations of mechanical engineers to develop creative products and solutions. By leveraging our strengths, we aspire to solve some of the biggest challenges facing our world.

During the 2022–2023 academic year, faculty, staff, and students at MechE continued to execute our research and educational missions.

Current Goals, Objectives, and Priorities

- Facilitate intradepartmental research collaborations that focus on the MechE Grand Challenges:
  - Health of the Planet and Health of the People
  - Global Energy Sustainability
  - Robotics, Autonomy, and Intelligent Systems
  - Design and Manufacturing Innovation
- Support Grand Challenges through seed funding and support for larger collaborative initiatives.
- Continue to hire diverse star junior faculty in areas of strategic importance, including design, manufacturing, and ocean science and engineering.
- Pioneer new pedagogy and innovations in teaching, including expansion of guided discovery.
- Continue to perform an extensive curriculum review with consideration on computing, ethics, and DEI.
- Continue to develop computing and data science in our MechE programs including new computing undergraduate tracks and the new data science track for our MEng.
- Do outreach and amplify the impact of mechanical engineers to first-year students and prospective students in an effort to better inform students about the department and encourage undergraduate enrollment.
- Improve the graduate student experience with a deeper understanding of the challenges with support from Institutional Research interviews and quantitative surveys.
- Increase outreach to female and underrepresented groups in an effort to encourage a more diverse cohort of incoming graduate students.
- Improve the student experience of our MEng for manufacturing program and continue to build on the new computing-focused MEng track.

- Support our students' career and professional development with the MechE Alliance program and graduate student coaching.
- Streamline and enhance the efficiency of operations by building systems in coordination with institute initiatives.
- Provide a healthy work environment for current administrative and support staff, and hire and retain people who excel.
- Foster a deeper sense of community – particularly in light of hybrid work and develop new effective hybrid work models for a post-pandemic world.
- Create and promote a more diverse, equitable, and inclusive department and community with faculty, staff and students.
- Prioritize and execute the MechE DEI Action Plan in coordination with Institute efforts.
- Enhance space for education, research, operations, and community.
- After the completion of the Newman Robotics Lab renovation, continue our space expansion and renovations including the start of the Building 3 Ziggurat and Roof 1 extensions, the completion of the overhaul of the basement of Building 5 with additional AHU capacity for new and existing faculty, and the renovations in Building 35.

Visiting Committee

The MIT Mechanical Engineering (MechE) Visiting Committee (VC) met in March 2023. The comprehensive and intense meeting both confirmed high achievements and revealed some significant challenges. The VC also included informal lab tours and dinner on the evening before the formal agenda. The key points reported by the VC were:

- The VC welcomed the increasingly interdisciplinary nature of the Department, and discussed whether the Department should be rebranded as something like "Mechanical and Systems Engineering," given its broad scope and strength in many areas.
- Strengths and achievements highlighted included the quality and experience of the faculty, the remarkable breadth and depth of research, high standards of teaching, the continuing successful integration of computation, the halting of the decline in the number of undergrads choosing MechE as a major, and space allocation improvements which had been the top issue for the past six VCs.
- Areas identified as needing attention were the strain on administrative systems, compensation of staff and graduate students, faculty reports of a perceived decline in student depth of understanding of concepts and capabilities in building physical systems, and high passions and concerns related to diversity, equity, and inclusion (DEI), leading the VC to recommend rebooting the Department's DEI efforts.

Department Head Search and Hire

At the end of December 2022, MechE Department Head Evelyn Wang was confirmed as director of the US Department of Energy's Advanced Research Projects Agency-Energy and stepped down as Department Head. Professors Rohit N Karnik and Pierre F.J Lermusiaux served as co-Interim Department Heads following her departure. A committee was convened to find a replacement. With the full support of the department, Dean Chandrakasan appointed a member of the MechE staff, for the first time, to the search advisory committee. In addition, the search chair prioritized outreach to key administrative staff and held open forums. Weighing input collected via interviews and meetings with faculty and research scientists, staff, post-docs, graduate students, undergraduate students, alums, and Visiting Committee members, the committee spent three months evaluating candidates before making final recommendations. Dean Chandrakasan then appointed the new Department Head, Professor John Hart, SM '02, Ph.D. '06, who took office on July 1, 2023.

Accomplishments

Rankings

MechE was named the number one graduate program and number one undergraduate program in Mechanical Engineering for 2022-2023 by U.S News, and the top mechanical engineering program in the world by QS World University Rankings.

Diversity, Equity, and Inclusion Initiatives

Guided by the work of the MechE DEI Task Force, the department continued to work toward increasing diversity and prioritizing inclusivity. We launched new programs, and continued and expanded our existing programs to enhance diversity and empower women and underserved students, including MechE Futures (encouraging women and underrepresented undergraduate students to pursue graduate degrees), MechE ENGAGE (peer mentoring of incoming women and underrepresented minority graduate students), Rising Stars (workshop to prepare women for academic careers), and a coaching program for graduate students.

Using the DEI Task Force's work as the foundation, department leadership developed a Strategic Action Plan to define specific action items with a few-year time horizon to continue to work toward our goal of building an inclusive, diverse, and equitable community.

This was also a growing and learning year in the DEI space and there is more work to do. After the Visiting Committee recommended rebooting the department's DEI efforts, implementation of the Strategic Action Plan was paused until the new leadership can build consensus and take initiatives forward.

MechE Alliance Program

The MechE Alliance serves to strengthen the department's connections with industry. We have recently been piloting small-scale industry projects within the structure of the MEng in Advanced Manufacturing Program but focusing on the overlap between physical systems and data and computing. The pilot has demonstrated interest from both industry and students. If pursued, this could someday serve as a 5th-year opportunity for graduate students. We also utilize our industrial connections to sustain multiple career exploration and skill-building activities in collaboration with campus resources. Additional industry programs are being planned.

MechE ENGAGE

MechE ENGAGE brings first-year graduate students in the department of mechanical engineering into mentorship pods with more experienced graduate student mentors and a faculty mentor. Students discuss and share advice regarding common challenges facing students as they transition into grad school. This helps students excel in graduate school by expanding their network of support and building confidence. During the three years of the program, we met our enrollment goal of 20 students and have received consistently positive feedback from participants.

Rising Stars in Mechanical Engineering

Rising Stars was not held at MIT in 2022. MIT will host in 2024.

Futures in Mechanical Engineering

Through Futures in MechE, the department conducts active outreach to juniors and seniors from underrepresented backgrounds at universities across the country and provides encouragement and resources for considering and applying to graduate school in mechanical engineering. We reached around 500 students through individual email outreach, over 100 of whom registered for at least one instance of a virtual seminar series hosted by the program leading up to our application deadline. Since the program began, the department has seen a modest but sustained increase in applications and admissions from women and URM students; comparable to other times when faculty have actively worked on recruitment but requiring fewer resources.

The Ibn Khaldun Fellowship for Saudi Arabian Women

The Ibn Khaldun Fellowship for Saudi Arabian Women (IBK) places 5 postdoc fellows per year in labs across MIT after a competitive selection process. For the 2022-2023 cohort, we had a 6.3% acceptance rate and our postdocs joined diverse research teams in acoustics, energy storage, AI for healthcare, soft electronics, and cancer biology. In an exciting first for us, Sharifa Alghowinem was hired as a research scientist at MIT in the Media Lab's Personal Robots Group which she originally joined as an IBK postdoc.

Coaching

Our coaching program, led by Dr. Kelli Hendrickson and Dr. Y. Jenny Wang, aims to support graduate students in small cohorts to develop creative solutions that foster continuous growth and professional development. In the past year, the program has continued with a focus on in-person cohorts, expanding our collaboration with EECS and introducing additional stand-alone events and workshops for students who cannot commit to a semester-long cohort. This summer, the program launched the three-day "Coaching Skills for Engineers" workshop in collaboration with EECS and the Riccio Graduate Engineering Leadership Program as an experiential learning effort to demonstrate how the coaching mindset can enhance innovation and collaborative efforts and help students develop as mentors and team leaders.

Renovating and Enhancing Space for Education and Research

We are improving spaces on campus for education and research. In particular, we: (i) Completed the renovation of the Newman Laboratory; (ii) Are adding additional air handling capacity to both Buildings 3 and 5, enabling future activities and providing new lab spaces in Building 5; (iii) Renovated lab space and desk spaces for a large number of new and existing faculty members and researchers, including graduate student spaces; (iv) Upgraded teaching labs and machine shops, classrooms, conference spaces, staff offices, hallways, and obtained new storage spaces; (v) Organized a second SoE report on infrastructure needs that was shared with the Provost office; and (vi) Completed the Construction Design sets and received pricing and approvals for the future renovations of the Ziggurat space in Building 3, 4th Floor, and of the adjacent roof addition (5,000 sf) in Building 1. This latter renovation will add much-needed spaces and act as a dynamic hub for research and education, spanning all expertise in the department. Finally, we received a written commitment from the Associate Provost for a future increase in the net assignable space for MechE (21,327 sf in Buildings 3, 7, and 5) that will provide a significant portion of the much-needed space for our students, faculty, and staff. An overview of the main space projects follows.

Completed

- We completed the renovation of The Newman Lab (Bldg 3., Floor 1), which houses Profs. Ian Hunter, Neville Hogan, Sangbae Kim, Lynette Jones, and Igo Krebs, as well as new collaborative laboratory space, hands-on classrooms, and a meeting room. The new space has a large mezzanine, teaching/conference spaces, a chemistry area, a machine space, and individual labs for PIs. We increased both the available space and its usability with open labs and new windows, providing a fully ADA-compliant shared research lab and teaching space, and a mezzanine running for the length of the lab.
- 5-011 was remodeled for new Prof. Ritu Raman. It has biosafety cabinets, a fume hood, and snorkel exhaust for her research.
- 3-072 was renovated as a permanent computational lab for Prof. Navid Azizan. This included new finishes, power, and tel/data.
- 35-333 has been renovated for new Prof. Kaitlyn Becker. The work included power, air, exhaust, and mechanical upgrades to the space.

In Construction

- 1-115 is being changed from temporary lab/class space to an office area.
- 5-017 is being modernized into a large lab for new Prof. Loza Tadesse. The space will have biosafety cabinets, fume hoods, and an optical area to accommodate her research.
- To support new and future research, the Tadesse and Raman labs are getting a new air handler and lab exhaust fans. MechE teams are working directly with MIT Facilities to install equipment.
- 5-021 was identified as being deficient for supply and exhaust air. As part of the air handler project, proper ventilation will be added to the lab for Prof. Cullen Buie.
- 5-218 and 5-220 is being turned into a computational lab for new Prof. Sherrie Wang. This includes abating all asbestos, adding power, tel/data, and new flooring.

In Planning

- Building 3 Ziggurat Renovation and Roof 1 addition is converting a large non-ADA compliant space into collaboration and gathering space and adding 5,000 square feet. It will include a multi-use roof deck and a 3,000 square foot addition with a wet lab and large workshop area. This space is designed to be flexible and can be used for labs or classes. Constructions drawings are in-hand, work can start when the remaining funding needed is secured.
- Faez Ahmed Lab Renovation is creating a computational lab along with student seating. It includes utility and finish upgrades throughout 35-332, 331, and 329.
- Utility upgrades to support added equipment are planned for Sveta Boriskina's lab in 5-007A and 7-012.
- CRSP is matching department funds to update the Shao-Horn lab in building 31, floor 1. This will include ceiling, flooring, and casework upgrades, along with a new acid resistant fume hood.
- Betar Gallant's lab in 3-315 had inadequate exhaust. We are adding two new exhaust fans for redundancy with updated controls, and we're maximizing storage by enclosing a hallway niche outside of the lab.
- Many small moves and renovations are also underway, most involving personal offices.

Communications and Media

MechE Communications and Media shares stories about research, education, people, and culture to internal and external audiences. The Fall/Winter 2022 issue of *MechE Connects* magazine focused on Engineering Entrepreneurs. Other highlights include:

MechE produced seven videos:

- The MIT Graduate Journey
- MIT Professor Is Unlocking a More Sustainable Future with Electrochemistry
- Finding a Balance at MIT
- MIT class educates future naval leaders.
- Class opens door to a new world of mechanical engineering.
- The MIT Mechanical Engineering Graduate Class of 2023
- Biologically Inspired Robots

MechE contributed the following articles to *MIT News*:

- Crystan McLymore SM '23: Excelling at sea and in the lab
- Bioinspired robotics class offers intriguing surprises

- Three MIT-led projects awarded MURI funding for 2023
- John Hart named head of the Department of Mechanical Engineering
- Five MIT faculty elected to the National Academy of Sciences for 2023
- Adventures in the Pappalardo Lab
- Asegun Henry wins National Science Foundation's Alan T. Waterman Award
- Ellen Roche and Justin Solomon named Edgerton Award winners
- Learning challenges shape a mechanical engineer's path
- 3 Questions: Cullen Buie on a new era for cell therapies
- Startups led by MIT mechanical engineers offer health care solutions
- Leslie Regan: A legacy of care and compassion for generations of graduate alumni
- Strengthening America's manufacturing base
- Manufacturing a cleaner future
- Evelyn Wang appointed as director of US Department of Energy's Advanced Research Projects Agency-Energy
- Class opens the door to a new world of mechanical engineering
- Educating future naval leaders
- Channeling creativity through art and engineering
- Pesticide innovation takes top prize at Collegiate Inventors Competition
- Protecting maternal health in Rwanda
- A lasting — and valuable — legacy
- The challenges and triumphs of the graduate experience

Social Media

MechE also continues to be a top performer across popular social media channels. Our fastest growing platform, LinkedIn, mirrored last year's growth with a 58% increase in followers. We were among the first DLCs to launch a presence on TikTok, and also continue to grow this space.

Events

In-person community events, including a Fall Block Party, Holiday Party, and various staff and faculty celebrations, continued to be a priority. We celebrated our final Health of the Planet Showcase in April, marking the conclusion of the Fay and Alfred D. Chandler Jr. Research Fellowship. We also hosted a celebration for the opening of the Newman Lab during commencement week, allowing alumni, community members, and others to tour the fully renovated and expanded research and education space.

Administrative Initiatives

MechE Staff Committee

The MechE Staff Committee creates space for staff to talk through concerns and ideas, works to understand the staff perspective, and promotes ideas for continual departmental improvement. In collaboration with the Director of Administration and Finance, the Committee enacted the following initiatives during FY23:

- Following comprehensive feedback gathering involving all faculty support staff, a “Faculty Support Staff Role Description” was created to build a shared understanding of common responsibilities and facilitate identification of tasks which may be “outliers.”
- The staff annual review process was overhauled to prompt for deeper reflection, define core competencies to better calibrate reviews across roles in the same job category, and provide faculty with consistent information about support staff roles to aid in evaluation. A review template for faculty support staff was introduced to facilitate consistent information gathering.
- The MIT Quality of Life Survey data for MechE was reviewed and used to create a summary report to facilitate reflection and identify common goals among staff in areas with opportunity impact wellbeing.

MechE Operations Group

The Director of Administration and Finance (DAF) made a renewed commitment to gather key administrative staff managers to understand how we can work together to tackle common challenges and improve administrative effectiveness of the department. This culminated in a retreat on reducing burnout in ourselves and our teams, from which resulted a list of actionable steps the group is prioritizing in the coming year.

Development of Web-Based Systems and Resources

Staff across the department continue to be actively involved in the development of web-based systems and tools such as QuickBase and Drupal. These resources are critical for dynamic management of operations, research, and education. Efforts in FY23 focused on applications for the GIB office, space management, and tracking of faculty data. An upgrade to FileMaker in our graduate office is nearing completion, which will provide a robust data management system able to create complex reports and targeted emails, and address other needs, while eliminating considerable time spent on manual data entry.

Collaborative Work with Other Departments

Staff participate in the MIT School of Engineering Staff Advice and Implementation Committee (SAIC) and actively collaborate with other SoE departments through the Director of Administration and Finance network. Meeting regularly allows for more effective advocacy for needs at the DLCI level. The focus in FY23 has continued on strengthening the partnership between DLCIs and the Dean’s Office in SoE and the broader engagement of DLCI staff in cooperative policy-development and decision making, as well as advocacy for the development of new resources and tools to support collaboration. These efforts are having a positive impact. Results of advocacy this last year include the recent change in title for all Administrative Officers at the Institute to DAFs.

Staffing

We continue to work to ensure appropriate staffing to best support the evolving needs of the department, while also ensuring that staff are not overwhelmed. This includes:

- Creating opportunities for staff promotions that support the department's needs while retaining top talent. This year, three staff members were promoted into key roles: Amanda Holley to Manager of Human Resources; Tom Graffeo to Facilities Administrator; and Paul Keen to Senior Leadership Giving Officer.
- Reorganizing teams and reclassifying roles in response to business need. We hired a senior financial administrator to manage the GIB office. The position was previously at the financial officer level; this change better supports the complex needs of the department. Additionally, we restructured the HR team, adding 2 HR coordinator roles and an HR administrator.

Fundraising and Development

In FY23, the Department of Mechanical Engineering received a total of $16,212,748 in new gifts and pledges (NGNP), representing an 86% increase from FY22's NGNP total of $8,732,870. The FY23 NGNP total includes gifts from 812 donors, up from 717 donors in FY22. $1M+ gifts and new pledges during the fiscal year included a $3,080,000 gift for graduate student fellowships and faculty research, as well as two additional $1M gifts for graduate student support. The department also received a new $2M pledge as a bequest and two additional $1M+ gifts/grants in support of faculty research.

Personnel Information

New Chairs:

- Ellen Roche – Latham Family Career Development Professor. Effective 07/01/2022.
- Sili Deng – Class of 1954 Career Development Professor. Effective 07/01/2022.
- Betar Gallant – Class of 1922 Career Development Professor. Effective 07/01/2022.
- Navid Azizan – Edgerton Career Development Professor. Effective 07/01/2022.
- Wim van Rees – American Bureau of Shipping Career Development Professor. Effective 07/01/2022.
- Kaitlyn Becker – Brit (1961) and Alex (1949) d'Arbeloff Career Development Professor. Effective 07/01/2022.
- Domitilla del Vecchio – George N. Hatsopoulos (1949) Faculty Fellowship in Interdisciplinary Research. Effective 11/01/2022 to 10/30/2024.

- Loza Tadesse – Brit (1961) and Alex (1949) d'Arbeloff Career Development Professor. Effective 12/07/2022.
- Sherrie Wang – Brit (1961) and Alex (1949) d'Arbeloff Career Development Professor. Effective 04/01/2023.
- Gio Traverso – Karl R. Van Tassel (1925) Career Development Professor. Effective 01/07/2023 to 30/06/2026.
- Vivishek Sudhir – Class of 1957 Career Development Professorship. Effective 01/07/2023 to 30/06/2026.

Departures:

- Alberto Rodriguez – Visiting Professor, 07/2023.

Leaves:

- David Wallace – FT22 Sabbatical.
- Kim Vandiver – FT22 Sabbatical.
- Peko Hosoi – FT22 Sabbatical.
- Tonio Buonassisi – FT22 Parental.
- Irmgard Bischofberger – FT22 Junior Faculty.
- Sanjay Sarma – FT22/ST23 Sabbatical.
- Warren Seering – FT22/ST23 Sabbatical.
- Jeehwan Kim – FT22/ST23 Sabbatical.
- Alberto Rodriguez – FT22/ST23 Professional Leave.
- Evelyn Wang – ST23.

Promotions:

- Betar Gallant – Associate w/ Tenure effective 07/01/23.
- Ellen Roche – Associate w/ Tenure effective 07/01/23.
- Gio Traverso – Associate w/out Tenure effective 07/01/23.
- Asegun Henry – Full Professor effective 07/01/23.
- Christopher MacLean – 2N Navy Associate Professor of the Practice, 2N Navy Program.
- Andrew Gillespy – Professor of the Practice, 2N Navy Program.

Retirements:

- Tomasz Wierzbicki – Retired as of 01/2023.

Awards and Honors

The following faculty, students, staff, and alumni won awards this past year:

Faculty, Research Staff, and Teaching Staff

- Asegun Henry: NSF The Alan T. Waterman Award and Physics World Top 10 Breakthroughs of 2022: Super-efficient electricity generation
- Betar Gallant: Electrochemical Society Toyota Young Investigator Fellowship
- Carlos Portela: 2023 Spira Award for Excellence in Teaching
- David Wallace: Class of 1960 Innovation in Education Fellow
- Domitilla Del Vecchio: Fellow of the International Federation of Automatic Control
- Ellen Roche: LabCentral Ignite Golden Ticket and 2022-2023 Harold E. Edgerton Faculty Achievement Award
- Evelyn Wang: 2022 Clarivate Highly Cited Researcher and AAA&S Fellow
- Faez Ahmed: 2022 3M Non-Tenured Faculty Award
- Gang Chen: 2022 Clarivate Highly Cited Researcher and National Academy of Sciences – Member
- Gareth McKinley: G.I. Taylor Medal and Election as a Corresponding Member of the Australian Academy of Science
- Michaela Geri: Society of Rheology Best Paper Award
- George Barbastathis: SPIE Fellow 2022 and Nat Academy of Medicine 2022 Emerging Leaders in Health and Medicine Scholar
- Giovanni Traverso: NAI Fellow and 2023 Acta Biomaterialia Silver Medal Recipient
- Harry Asada: 2023 Pioneer in Robotics and Automation Award
- John Lienhard: More Water Less Concentrate Grand Prize
- Lydia Bourouiba: Paul Gray Award for Public Service and G.K. Batchelor Lecturer at the University of Cambridge
- Markus Buehler: 2022 IACM Fellows Award, James R. Rice Medal, and NAE Fellow
- Navid Azizan: 2023 Outstanding UROP Faculty Mentor Award
- Peko Hosoi: MIT's Earll M. Murman Award for Excellence in Undergraduate Advising
- Pierre Lermusiaux: SIAM Activity Group on Mathematics of Planet Earth 2023-2024 Chair
- Ritu Raman: CAREER award from the National Science Foundation

- Roger Kamm: NAE Fellow
- Scott Manalis: 2023 Koch Institute Image Awards
- Svetlana Boriskina: MISTI Global Seed Fund grants
- Tonio Buonassisi: 2022 Clarivate Highly Cited Researcher
- Xuanhe Zhao: 2022 Clarivate Highly Cited Researcher
- Yang Shao-Horn: 2022 Clarivate Highly Cited Researcher

Staff

- Christina Spinelli: Joseph (Tiny) Caloggero Service Award
- Janice McCarthy: Infinite Mile Award
- John Freidah: Best of District I Award
- Justin Silva: Joseph (Tiny) Caloggero Service Award

Teaching and Curriculum

Education Innovation

We are dedicated to improving our curriculum and developing new innovative pedagogical tools. A comprehensive departmental curriculum review, the first such effort in more than two decades, continued this year. The Mechanical Engineering Computing and Curriculum Review Committee, co-chaired by Peko Hosoi and Sangbae Kim, is charged with developing a vision for the future of mechanical engineering education by redefining our unique strengths, articulating educational goals (including the integration of data science and computing), developing specific goal accomplishment recommendations, and outlining potential pathways for implementation. The Committee successfully engaged faculty, conducted workshops and retreats, and is poised to report its recommendations by Fall '23.

We have also continued to support advancing guided discovery and related pedagogical approaches – namely concept questions, analysis problems, and design problems – under the leadership of Ely Sachs. We envision incorporating use of these methods into our undergraduate curriculum to help consolidate student's ability to understand and apply the fundamentals, and, in 5-10 years, aim to disseminate these approaches to other departments and universities. Our faculty continued to innovate in education and develop new subjects to keep the curriculum up to date with the latest developments.

We implemented a new graduate advising form, developed in collaboration with students and designed to enhance advisor-advisee relationships between faculty and graduate students.

An analysis of the PhD Qualifying Exam, which is a point of great concern for students, was performed to organize and lay out goals, benefits, drawbacks, and potential solutions, forming a basis on which any potential changes may be made in the future.

Enrollment

Table 1: Undergraduate Enrollment, AY2018–AY2022

Course by year	AY2018	AY2019	AY2020	AY2021	AY2022
2 sophomores	71	64	53	36	38
2-A sophomores	94	80	76	84	97
2-OE sophomores	2	1	0	2	0
Sophomores subtotal	**167**	**145**	**129**	**122**	**135**
2 Juniors	70	86	59	55	40
2-A Juniors	69	71	61	83	69
2-OE Juniors	3	2	1	0	2
Juniors subtotal	**152**	**159**	**121**	**138**	**111**
2 Seniors	93	70	61	68	42
2-A Seniors	83	72	80	66	85
2-OE Seniors	3	3	2	1	0
Seniors Subtotal	**179**	**145**	**143**	**135**	**127**
2 5th-year students	6	4	2	8	10
2-A 5th-year students	4	9	8	11	10
2-OE 5th-year students	0	0	0	0	0
5th-year students Subtotal	**10**	**13**	**10**	**19**	**20**
Total	**508**	**462**	**403**	**414**	**393**

Table 2: Graduate Enrollment, AY2018–AY2022

Graduate level	AY2018	AY2019	AY2020	AY2021	AY2022
Master’s	190	187	194	136	140
Doctoral	294	268	244	245	243
Meng	9	11	9	27	16
MechE	0	2	1	0	0
Eng (naval)	31	27	25	28	29
Total	**524**	**495**	**473**	**436**	**428**

Research Activities

Research Highlights

The following research papers provide a snapshot of the groundbreaking work published by MechE faculty and researchers this past year (in chronological order):

- Engineers repurpose 19th-century photography technique to make stretchy, color-changing films—MIT Engineers led by Mathias Kolle repurposed 19th-century photography technique to make stretchy, color-changing films.
- Passive cooling system could benefit off-grid location—An innovative system developed by a team of engineers including Evelyn Wang offers a way to use passive cooling to preserve food crops and supplement conventional air conditioners, with no need for power and only a small need for water.

- Ocean scientists measure sediment plume stirred up by deep-sea-mining vehicle—Professor Thomas Peacock examined the cloud of sediment that a collector vehicle would stir up as it picks up polymetallic nodules from the seafloor.
- New materials could enable longer-lasting implantable batteries—Researchers at MIT, including Associate Professor Betar Gallant, Dr. Haining Gao, and grad student Alejandro Sevilla, came up with a way to improve the energy density of non-rechargeable batteries.
- Moving Water and Earth—Professor Ken Kamrin, Taylor Perron, and team developed a more accurate formula to calculate how much sediment a fluid can push across a granular bed, which could help engineers manage river restoration and coastal erosion.
- Engineers invent vertical, full-color microscopic LEDs—Associate Professor Jeehwan Kim and team developed a new way to make sharper, defect-free displays by inventing a way to stack the diodes to create vertical, multicolored pixels.
- Ingestible sensor could help doctors pinpoint GI difficulties—An ingestible sensor developed by Associate Professor Giovanni Traverso and his team could help doctors pinpoint GI difficulties. The sensor sends out its location as it moves through the GI tract and reveals where slowdowns in digestion may occur.
- How to pull carbon dioxide out of seawater—Kripa Varanasi and researchers from MIT ChemE found an effective new method for removing greenhouse gas from the ocean.
- Using combustion to make better batteries—Assistant Professor Sili Deng and her team harness combustion to yield valuable materials, including some critical in the manufacture of lithium-ion batteries.
- Custom, 3D-printed heart replicas look and pump just like the real thing—Professor Ellen Roche and team have developed a procedure to 3D print a soft and flexible replica of a patient's heart to help tailor treatments to patients' specific heart form and function.
- Speedy robo-gripper reflexively organizes cluttered spaces—Professor Sangbae Kim's Biomimetics Lab developed a gripper that grasps by reflex. Rather than start from scratch after a failed attempt, the robot adapts to reflexively roll, palm, or pinch an object to get a better hold.
- Researchers develop novel AI-based estimator for manufacturing medicine—A collaborative research team from the MIT-Takeda Program, including Professor George Barbastathis, combined physics and machine learning to characterize rough particle surfaces in pharmaceutical pills and powders.
- Turning a circle into a square is possible with this kirigami-inspired formula—A study by Assistant Professor Kaitlyn Becker, inspired by Japanese paper-cutting art, provides a blueprint for designing shape-shifting materials and devices.

Intradepartmental Research Collaboration: Focus on Grand Challenges

MechE continued efforts to increase discussions and opportunities for intradepartmental research collaborations in the four Grand Challenge areas previously identified. Five new teams were selected as part of the third call of our MathWorks Seed Fund Program. The progress by this third call teams will be presented at the "Audacious Research Projects in MechE" Event in Fall 2023.

Conclusion

We continue to execute our education and research mission, publish high-impact research on some of the most pressing challenges our world faces, and advance our efforts to make MechE a diverse, equitable, and inclusive environment, and our talented teaching staff provided a world-class education to the next generation of mechanical engineers. We look forward to renewing our commitment to making MechE a great place to work and learn, while developing solutions to the world's Grand Challenges in the years ahead.

Pierre Lermusiaux
Nam P. Suh Professor of Mechanical Engineering, Associate Department Head for Research and Operations, Interim Co-Department Head

Rohit Karnik
Tata Professor, Associate Department Head for Education, Interim Co-Department Head