Department of Mechanical Engineering

The Department of Mechanical Engineering (ME) welcomed three new faculty members this past year. Professor Daniela de Farias received her PhD from Stanford and spent a year at IBM Almaden before coming to MIT. She works in the area of operations research. Her particular expertise meshes well with a number of mechanical engineering problems ranging from control, manufacturing and design to robotics, biomechanics, and information technology. Professor Thomas Peacock has his PhD from the University of Oxford and works in nonlinear dynamics. Among his various research projects is work on the mixing of fluids, the use of microsensors to control flow, and the mechanics of liquid crystals. Professor Linda Griffith joined the department as a full professor of mechanical engineering with a dual appointment as professor of biological engineering. She is a renowned leader in the area of tissue engineering and is highly recognized for her work on biomaterials, the kinetics of tissue regeneration, and the design and building of devices to assist in tissue reconstruction. Linda is a fellow of the American Institute of Medical and Biological Engineers. She will play a leading role in advising undergraduate students in the 2A biotrack.

The new laboratories that we began renovating last year have now been completed and are bustling with activity. The Batteries and Fuel Cell Laboratory is part of our Center for 21st-Century Energy. Both the Nonlinear Dynamics Laboratory and the Biomaterials Laboratory are part of our broad activities in mechanics and materials; ongoing work in these facilities includes investigating modern ideas concerning nonlinear dynamic phenomena in structures and fluids and in developing and characterizing a variety of biological tissues and organs. The Biophysics Laboratory cuts across our different disciplinary thrusts with ongoing projects on developing nanoparticles as antennas to switch on and off the activity of single biomolecules and on the mechanics of cells and molecules. Design and manufacturing research aimed at developing miniature electric generators, miniature chemical lasers, and self-assembly–based techniques for micro- and nanoscale manufacturing is currently ongoing in temporary space but will move into the proposed new Pappalardo Laboratory for Nanoscale Engineering.

The Graduate (Student) Association of Mechanical Engineers (GAME) and the ME Graduate Women Association (MEGAWomen) have been playing a central role in the life of the department. Over the past year, they hosted a number of social activities for the graduate students. In addition to these, GAME has sponsored a seminar series, published a seasonal newsletter, and worked on mentoring and orientation for new students to the department.

The department has been engaged in discussions about possibly merging with the Department of Ocean Engineering. We see opportunities in a merger, but only if executed carefully in order to avoid potential downfalls. These conversations are continuing.

Our students and faculty have continued to be recognized by numerous awards for their originality and impact on research, education, and leadership, as listed below.

The department is continuing to focus attention on the broad area of energy, including renewable energy. Timothy Gutowski is examining the environmental impact of manufacturing and product design. Ernest Cravalho and Yang Shao-Horn are exploring fuel cells—devices that harness the oxidation of fuels to directly produce electricity but can also be run "backward," in which mode fuel cells can serve as storage devices for electricity created by renewable sources such as wind and photovoltaics. Emanuel Sachs is working on photovoltaics—solar panels that convert sunlight directly into electricity using semiconductor devices. Sachs is the inventor of the "String Ribbon" process for the manufacture of crystalline silicon substrates for solar cells, a process that is being commercialized by Evergreen Solar, and he is presently working on the metal "fingers" on top of a solar cell that collect the current from the cell. The department expects to set up a center for sustainable energy to foster and grow work in this area.

The Deshpande Center for Technological Innovation supports leading-edge research on emerging technologies and cultivates interaction between MIT, entrepreneurs, innovative companies, and venture capitalists. In addition to Woodie Flowers, Doug Hart, Sang-Gook Kim, Emanuel Sachs, Yang Shao-Horn and Alex Slocum, who have ongoing support, three ME faculty members received new awards from the Deshpande Center. They are Peter So for his work on noninvasive tissue biopsy, George Barbastathis for his work on a radio frequency microelectromechanical systems (RF MEMS) switch, and Todd Thorsen for his work on microfluidic biological assays.

Our commitment to continually improve and innovate the way we educate students remains strong. Harry Asada has developed a popular new robotics class for undergraduates. Carol Livermore has taken joint responsibility for a subject on MEMS and nanotechnology, taught jointly with the EECS Department. Ahmed Ghoniem and his colleagues developed a new subject on energy technologies that has proved to be very popular Institute-wide. Steve Dubowsky has developed a new seminar subject in design and control for graduate students where they will be exposed to leading-edge research. And the list goes on.

Course 2-A, the alternative mechanical engineering degree, which received Accreditation Board for Engineering and Technology accreditation last year, has begun to attract many students. Students in Course 2-A take the first level mechanical engineering subjects and then construct their own program for the remainder of their academic requirements. Students have found this ability to "self-design" their individual majors to be particularly attractive. In order to address a growing demand, we have developed well-defined bio and management tracks for students in this program.

We have continued to look for ways in which to also bring material related to biophysics, nanotechnology, and MEMS into the core Course 2 curriculum. We have made progress. Examples include the following: Matt Lang has developed a biomechanics micromanipulation experiment using optical tweezers for the lab subject 2.672; Kimberly Hamad-Schifferli has developed a biological materials module for the materials subject 2.002; Todd Thorsen is developing a microfluidics experiment for the

lab subject 2.672; and Carol Livermore is incorporating some MEMS–related problems and labs in our mechanics subject 2.001.

Undergraduate Program

Undergraduate Enrollment

	98–99	99–00	00–01	01–02	02–03	03–04
Sophomores	121	106	83	77	113	107
Juniors	117	116	91	92	72	108
Seniors	132	108	110	115	80	70
Total	**370**	**330**	**284**	**284**	**265**	**285**[a]

[a] Eight 5th-year students would make the total number 293.

The following honors and prizes were awarded to our undergraduate students:

- Outstanding Service to the Department Award: Christina M. Laskowski and Timothy W. Suen.
- Carl G. Sontheimer Prize for Creativity and Innovation in Design: Christopher J. Khan, Melissa B. Read, and Jonathan D. Rohrs.
- Thomas Sheridan Prize for Creativity in Man-Machine Integration: Matthew J. Carvey.
- The John C. and Elizabeth J. Chato Award for Excellence in Bioengineering: Dawn M. Wendell.
- Padmakar P. Lele Student Award for Academic Excellence: Nathan Ball and Daniel Walker.
- Padmakar P. Lele Student Award for Outstanding Thesis: Kristen E. Wolfe
- Padmakar P. Lele Student Award for UAs: Courtney A. Browne, Ross L. Hatton, Marissa L. Jacovich and Melissa B. Read.
- Luis De Florez Award for Ingenuity and Creativity: Nicholas R. Powley, Melissa B. Read, and Wey-Juin Lin.
- Peter Griffith Prize for Outstanding Experimental Projects: Roy K. Esaki and Tina Shih.
- AMP Inc. Award for Outstanding Performance in 2.002: Mika Tomczak and Michael T. Wolf.
- Whitelaw Prize for Originality in Design: Chandler E. Hatton and Mika Tomczak.
- International Design Competition Team: Samuel M. Felton, Adam S. Kaczmarek, Dean M. Ljubicic and Bryan Woodruff.
- The Wunsch Foundation Silent Hoist and Crane Award for Outstanding Undergraduate Project or Thesis: Erin L. Hult and Bryan P. Ruddy.
- The Wunsch Foundation Silent Hoist and Crane Award for Outstanding Performance in Course 2.008: Ethan L. Crumlin and Lynn K. Kamimoto.

Our Discover Mechanical Engineering team has been very active this past year and contributed significantly. The outstanding team of students in this activity has been ably led by Timothy Suen and Christina Laskowski.

Graduate Program

Our graduate program continues to be strong, with a total of 388 students. Of the 210 students in the master's program, 35% were foreign, 23% were women, and 7% were minorities. Of the 178 students in the doctoral program, 57% were foreign, 13% were women, and 3% were minorities. Our students were supported by 284 research assistantships, 28 teaching assistantships, 12 NSF fellowships, 10 DOD fellowships, 24 other fellowships, 3 awards from US industry, 3 awards from sources outside of the US, 8 LFM fellowships, 1 GEM, 2 EIP students, and 13 self-supported students.

Graduate Enrollment

	98–99	99–00	00–01	01–02	02–03	03–04
Masters	220	225	197	176	201	210
Doctoral	172	159	181	183	163	178
Total	**392**	**384**	**378**	**359**	**364**	**388**

This past year, 834 students applied for admission to our graduate program; 25% of them were offered admission, of whom 47% matriculated.

The following honors and prizes were awarded to our graduate students:

- Meredith Kamm Memorial Award for Outstanding Performance: Alicia J. Hardy.
- Joseph H. Keenan Award for outstanding graduate student in thermal sciences: Youssef Marzouk.

Faculty Notes

Professors Gang Chen and David Trumper were promoted to the rank of full professor.

- Professor Mary Boyce was elected a fellow of the American Academy of Arts and Sciences.
- Professor Frank McClintock received ASME's Daniel C. Drucker Medal.
- Professor Ali Argon has been awarded the 2004 Heyn Medal of the German Materials Society. This medal, which is the highest honor that the society bestows yearly, is in recognition of outstanding scientific or technological achievements in the field of materials. Over the past 50 years or so, only a handful of non-German honorees have been named, and that list is of outstanding technical caliber.
- Professors Lallit Anand, Roger Kamm and Alex Slocum were elected fellows of ASME.

- Professor Ian Hunter was received the Bose Award from the School of Engineering and the Keenan Award from the Department of Mechanical Engineering for innovation and excellence in education.
- Professor Martin Culpepper received the Spira Award for excellence in teaching.
- Professor Peter So was awarded the Frank E. Perkins Award for his excellence as an advisor and mentor to graduate students.
- Professor Martin Culpepper was awarded the Rockwell career development chair.
- Professor Daniela Pucci de Farias was awarded the Esther and Harold E. Edgerton career development chair.
- Professor Anette Hosoi was awarded the Doherty chair in ocean utilization.
- Professor Matthew Lang was awarded the W. M. Keck career development chair in biomedical engineering.
- Professor Carol Livermore was awarded the SMA career development assistant professorship in manufacturing.

Rohan Abeyaratne
Head
Quentin Berg Professor of Mechanical Engineering and MacVicar Faculty Fellow

Additional information about the Department of Mechanical Engineering can be found on the web at http://me.mit.edu/.