ENGINEERING MANAGEMENT (EM)

System Design and Management

EM.411 Foundations of System Design and Management
Prereq: Permission of instructor
G (Fall)
4-2-9 units

Presents the foundations of systems architecture, systems engineering and project management in an integrated format, through a synchronized combination of in-class discussion, industrial guest speakers, team projects, and individual assignments. Topics include stakeholder analysis, project planning and monitoring, requirements definition, concept generation and selection, complexity management, system integration, verification and validation, cost modeling, systems safety, organizational design and effective teamwork, risk management, and leadership styles. Restricted to students in the SDM program.
B. Moser, E. Crawley, B. Cameron

EM.412 Foundations of System Design and Management II
Prereq: EM.411
G (IAP)
2-1-3 units

Deepens the foundations of systems architecture, systems engineering and project management introduced in EM.411 though a synchronized combination of lectures, recitations, opportunity sets, guest speakers, and team projects. Topics emphasize the transition from early conceptual design to detailed design and system integration. Features a technology showcase and project forum where students, faculty and company sponsors meet to discuss and select projects for EM.413. Includes team-based exercises and design challenges. Restricted to students in the SDM program.
B. Cameron, E. Crawley, B. Moser

EM.413 Foundations of System Design and Management III
Prereq: EM.412
G (Spring)
4-2-9 units

Presents advanced concepts in systems architecture, systems engineering and project management in an integrated manner through lectures, recitations, opportunity sets, guest lectures, and a semester-long team project. Topics emphasize complexity management, systems integration, verification, validation, and lifecycle management. Specific lifecycle properties addressed include quality, safety, robustness, resilience, flexibility and evolvability of systems over time. Additional topics include monitoring and control, the rework cycle, managing portfolios and programs of projects in a multi-cultural and global context, and managing product families and platforms. Restricted to students in the SDM program.
B. Moser, B. Cameron, E. Crawley

EM.421 SDM Certificate Capstone
Prereq: EM.413
G (Summer)
1-0-8 units

Practical application of systems management problems within a real company. Teams of 1-4 students are matched with a company to work on a project in which they identify systems challenges and devise methods for solving problems utilizing the system architecture, systems engineering and project management methodology covered in the EM core sequence. Mentors and sponsors are identified for each team. Restricted to System Design and Management Certificate students.
J. Rubin

EM.422 System Design and Management for a Changing World: Combined
Engineering School-Wide Elective Subject.
Offered under: 1.146, 16.861, EM.422, IDS.332
Prereq: Permission of instructor
G (Fall)
3-0-9 units
Credit cannot also be received for EM.423[J], IDS.333[J]

See description under subject IDS.332. Enrollment limited.
R. de Neufville

EM.423[J] System Design and Management for a Changing World: Tools
Same subject as IDS.333[J]
Prereq: None
G (Fall; first half of term)
3-0-3 units
Credit cannot also be received for 1.146, 16.861, EM.422, IDS.332

See description under subject IDS.333[J].
R. de Neufville

EM.424[J] System Design and Management for a Changing World: Projects
Same subject as IDS.334[J]
Prereq: IDS.333[J] or permission of instructor
G (Fall, Spring)
3-0-3 units

See description under subject IDS.334[J].
R. de Neufville

EM.425 Research Seminar on Engineering Projects and Teamwork
Prereq: EM.411 or permission of instructor
G (Fall)
2-0-4 units

Review of research on engineering as work and problem-solving by teams, including cases, professional practices, experimental results, and teamwork fundamentals. Topics include: projects structures and dependence; communication, coordination, and concurrency; exception handling, rework, and quality; awareness, attention, and engagement; and information, uncertainty, and learning. Students consider engineering teamwork phenomena which integrate technical and organizational aspects, leading to insights on performance during project shaping, ideation, planning, control, adaptation, and lessons learned. In the second half, students work as small teams to propose an experiment which explores teamwork during engineering. Proposed experiments often become basis for research and thesis activity.
B. Moser, I. Vazquez

EM.426 Model-building and Analysis Lab for Engineering Project Teamwork
Prereq: EM.425 or permission of instructor
G (Spring)
1-1-4 units

Explores agent-based models and simulation for engineering project management. Students build and validate models of engineered systems and engineering teamwork, which integrate technology and organization useful during project shaping, ideation, planning, control, adaptation, and lessons learned. Models capture phenomena discussed in EM.425 and are simulated to forecast performance such as feasible scope, human activity, interactions, cost, schedule, quality, and risks. In the first half, students build a model and agent-based simulation from scratch. In the second half, students work in small teams on either a case modeled using methods introduced in the first half or an extension of said methods to explore a particular engineering phenomenon introduced in the first half.
B. Moser

EM.427[J] Technology Roadmapping and Development
Same subject as 16.887[J]
Prereq: Permission of instructor
Acad Year 2025-2026: G (Fall)
Acad Year 2026-2027: Not offered
3-0-9 units

See description under subject 16.887[J].
O. L. de Weck

EM.428[J] Multidisciplinary Design Optimization
Same subject as 16.888[J], IDS.338[J]
Prereq: 18.085 or permission of instructor
Acad Year 2025-2026: Not offered
Acad Year 2026-2027: G (Fall)
3-1-8 units

Systems modeling for design and optimization. Selection of design variables, objective functions and constraints. Overview of principles, methods and tools in multidisciplinary design optimization (MDO). Subsystem identification, development and interface design. Design of experiments (DOE). Review of linear (LP) and non-linear (NLP) constrained optimization formulations. Scalar versus vector optimization problems. Karush-Kuhn-Tucker (KKT) conditions of optimality, Lagrange multipliers, adjoints, gradient search methods, sensitivity analysis, geometric programming, simulated annealing, genetic algorithms and particle swarm optimization. Constraint satisfaction problems and isoperformance. Non-dominance and Pareto frontiers. Surrogate models and multifidelity optimization strategies. System design for value. Students execute a term project in small teams related to their area of interest.
O. de Weck

EM.429[J] Systems Architecting Applied to Enterprises
Same subject as 16.855[J], IDS.336[J]
Prereq: Permission of instructor
G (Spring)
3-0-9 units

See description under subject IDS.336[J].
D. Rhodes

EM.431[J] Applied Category Theory for Engineering Design (New)
Same subject as 1.144[J], 11.214[J], 16.880[J], IDS.344[J]
Subject meets with 1.044[J], 11.114[J]
Prereq: (Calculus II (GIR) and 18.06) or permission of instructor
G (Fall)
4-0-8 units

See description under subject 1.144[J].
G. Zardini

Internship and Thesis

EM.451 Internship Experience
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Units arranged
Can be repeated for credit.

Provides insight into the challenges of an organization that develops products or systems. Before enrolling each student must have a department approved internship opportunity. At the end of the internship, students deliver a report, for evaluation by the sponsoring faculty member, documenting ways that the organization addresses product or system development issues and applies the methods taught in the SDM or IDM core. Intended for students who have completed the SDM or IDM core course sequence.
Staff

EM.S20 Special Subject in Engineering Management
Prereq: Permission of instructor
G (Spring)
Units arranged

Opportunity for study of advanced topics in Engineering Management not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to department approval.
Staff

EM.S21 Special Subject in Engineering Management
Prereq: Permission of instructor
G (Fall)
Units arranged

Opportunity for study of advanced topics in Engineering Management not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to department approval.
Staff

EM.S22 Special Subject in Engineering Management
Prereq: Permission of instructor
G (Fall, Spring)
Units arranged

Opportunity for study of advanced topics in Engineering Management not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to department approval.
Staff

EM.THG EM Graduate Thesis
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Units arranged
Can be repeated for credit.

Program of research, leading to the writing of an SM thesis to be arranged by the student with an appropriate member of the MIT faculty.
Consult W, Foley