

Graduate Program

MS Industrial Engineering

www.ime.calpoly.edu/programs/graduate/

General Characteristics

The Master of Science in Industrial Engineering (MS IE) program is designed to prepare students for a successful career in industry as well as a further study in a Ph.D. program, building on its strength in learn-by-doing and project-based engineering education and focusing on applied research. Through the MS IE program, students will sharpen both technical skills and non-technical skills required for success in their careers.

Blended BS+MS Engineering Program

Students must be prepared for engineering practice via the curriculum which culminates in a major design experience based on the knowledge and skills acquired in earlier coursework and incorporating engineering standards and realistic constraints, as listed in the ABET Engineering Criteria. Therefore, "Blended BS + MS Program" students must complete a senior project with this major design experience requirement in order to complete the undergraduate degree.

Students may be eligible to pursue the blended program toward the MS in Industrial Engineering or the MS Engineering with a specialization in Integrated Technology Management. Please refer to the MS Engineering (p. 178) section of this catalog for more information and General Policies Governing Graduate Studies (p. 369) for eligibility criteria for blended programs.

BS Industrial Engineering

Program Learning Outcomes

1. An ability to apply knowledge of mathematics, science, and engineering
2. An ability to design and conduct experiments, as well as to analyze and interpret data
3. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (includes ability to design and develop integrated systems that include people, materials, information, equipment and energy)
4. An ability to function on multidisciplinary teams
5. An ability to identify, formulate, and solve engineering problems (including the ability to improve integrated systems of people, materials, information, equipment, and energy)
6. An understanding of professional and ethical responsibility
7. An ability to communicate effectively
8. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
9. A recognition of the need for, and an ability to engage in life-long learning
10. A knowledge of contemporary issues
11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (includes the ability to integrate systems of people, materials, information, equipment, and energy using appropriate analytical, computational, and

experimental practices as well as the ability to implement such systems)

Degree Requirements and Curriculum

In addition to the program requirements listed on this page, students must also satisfy requirements outlined in more detail in the Minimum Requirements for Graduation (p. 32) section of this catalog, including:

- 60 units of upper division courses
- 2.0 GPA
- Graduation Writing Requirement (GWR)
- U.S. Cultural Pluralism (USCP)

Note: No major or support courses may be taken as credit/no credit. No course may be double counted within the curriculum.

MAJOR COURSES

IME 101	Introduction to Industrial and Manufacturing Engineering	1
IME 140	Graphics Communication and Modeling	2
IME 141	Manufacturing Processes: Net Shape	1
IME 144	Introduction to Design and Manufacturing	4
IME 156	Basic Electronics Manufacturing	2
IME 223	Process Improvement Fundamentals	4
IME 239	Industrial Costs and Controls	3
IME 301	Operations Research I	4
IME 303	Project Organization and Management	4
IME 305	Operations Research II	4
IME 312	Data Management and System Design	4
IME 314	Engineering Economics	3
IME 319	Human Factors Engineering	3
IME 326	Engineering Test Design and Analysis	4
IME 410	Production Planning and Control Systems	4
IME 417	Supply Chain and Logistics Management	4
IME 420	Simulation	4
IME 429	Ergonomics Laboratory	1
IME 430	Quality Engineering	4
IME 443	Facilities Planning and Design	4
IME 481	Senior Project Design Laboratory I	2
IME 482	Senior Project Design Laboratory II	3

Technical Electives^{2, 3, 4, 5}

Select from the following:		10
AG/ISLA/ EDES/ENGR/ SCM/UNIV 350	The Global Environment	
BUS 310	Introduction to Entrepreneurship	
BUS 311	Managing Technology in the International Legal Environment	
BUS 346	Principles of Marketing	
BUS 382	Organizations, People, and Technology	
BUS 402	International Business Management	
BUS 404	Governmental and Social Influences on Business	
BUS 488	Planning and Managing New Ventures	
CE 207	Mechanics of Materials II	
EE 361	Electronics Laboratory	

EE 434	Automotive Engineering for a Sustainable Future	CHEM 124	General Chemistry for Physical Science and Engineering I (B3/B4) ¹	4
IME 142	Manufacturing Processes: Materials Joining	CSC 232	Computer Programming for Scientists and Engineers	3
IME 335	Computer-Aided Manufacturing I	EE 201	Electric Circuit Theory	3
IME 351	Advanced Material Removal Process Design	EE 251	Electric Circuits Laboratory	1
IME 356	Manufacturing Automation	EE 321	Electronics	3
IME 400	Special Problems for Advanced Undergraduates ⁶	ENGL 149	Technical Writing for Engineers (A3) ¹	4
IME 401	Sales Engineering	MATE 210	Materials Engineering	3
IME 408	Systems Engineering	MATE 215	Materials Laboratory I	1
IME 409	Economic Decision Systems	MATH 141	Calculus I (B1) ¹	4
IME 416	Automation of Industrial Systems	MATH 142	Calculus II (B1) ¹	4
IME 418	Product-Process Design	MATH 143	Calculus III (Add'l Area B) ¹	4
IME 427	Design of Experiments	MATH 241	Calculus IV	4
IME 428	Engineering Metrology	MATH 244	Linear Analysis I	4
IME 435	Reliability for Design and Testing	ME 211	Engineering Statics	3
IME 441	Engineering Supervision I	ME 212	Engineering Dynamics	3
IME 442	Engineering Supervision II	PHYS 132	General Physics II	4
IME 457	Advanced Electronic Manufacturing	PHYS 133	General Physics III	4
IME 458	Microelectronics and Electronics Packaging	PHYS 141	General Physics IA (Add'l Area B) ¹	4
IME 470	Selected Advanced Topics	PSY 201	General Psychology (D4) ¹	4
IME 471	Selected Advanced Laboratory	or PSY 202	General Psychology	
IME 500	Individual Study ⁶	STAT 321	Probability and Statistics for Engineers and Scientists (B6) ¹	4
IME/AERO 510	Systems Engineering I	GENERAL EDUCATION (GE)		
IME/AERO 511	Systems Engineering II	(See GE program requirements below.)		36
IME 541	Advanced Operations Research	FREE ELECTIVES		
IME 542	Applied Reliability Engineering	Free Electives		0
IME 543	Applied Human Factors	Total units		190
IME 544	Advanced Topics in Engineering Economy	¹ Required in Support; also satisfies GE. ² Courses meeting technical electives may not be used to satisfy other major, support, or general education requirements (no double counting of coursework). ³ At least 6 units of technical electives must be upper division (300-level or above) engineering or computer science courses. ⁴ A maximum of 4 units of technical electives may be upper division (300-level or above) courses from outside of the College of Engineering or lower division (100 or 200 level) engineering or computer science courses. ⁵ Consultation with advisor is recommended prior to selecting technical electives; bear in mind your selections may impact pursuit of post-baccalaureate studies and/or goals. Upper division courses not on this list may substitute as technical electives if approved by advisor and IME department chair. ⁶ IME 400 and IME 500 require a special problems form and no more than 4 total units are allowed.		
IME 545	Advanced Topics in Simulation	General Education (GE) Requirements		
IME 556	Technological Project Management	<ul style="list-style-type: none"> • 72 units required, 36 of which are specified in Major and/or Support. • See the complete GE course listing (p. 32). • Minimum of 8 units required at the 300 level. 		
IME 577	Engineering Entrepreneurship			
IT 341	Packaging Polymers and Processing			
IT 406	Industrial Sales			
IT 428	Commercialization of New Technologies			
MATE 410	Nanoscale Engineering			
MATH 344	Linear Analysis II			
MATH 350	Mathematical Software			
ME 302	Thermodynamics I			
ME 305	Introduction to Mechatronics			
ME 341	Fluid Mechanics I			
PSY 350	Teamwork			
STAT 324	Applied Regression Analysis			
STAT 330	Statistical Computing with SAS			
STAT 331	Statistical Computing with R			
STAT 416	Statistical Analysis of Time Series			
SUPPORT COURSES				
BIO 213 & BMED 213	Life Science for Engineers and Bioengineering Fundamentals (B2) ¹			4
CE 204	Mechanics of Materials I			3

Area A	Communication	
A1	Expository Writing	4
A2	Oral Communication	4
A3	Reasoning, Argumentation and Writing (4 units in Support) ¹	0
Area B	Science and Mathematics	
B1	Mathematics/Statistics (8 units in Support) ¹	0
B2	Life Science (4 units in Support) ¹	0
B3	Physical Science (4 units in Support) ¹	0
B4	One lab taken with either a B2 or B3 course	
B6	Upper-division Area B (4 units in Support) ¹	0
Additional Area B units (8 units in Support) ¹		0
Area C	Arts and Humanities	
C1	Literature	4
C2	Philosophy	4
C3	Fine/Performing Arts	4
C4	Upper-division elective	4
Area D/E	Society and the Individual	
D1	The American Experience (Title 5, Section 40404 requirement) (40404)	4
D2	Political Economy	4
D3	Comparative Social Institutions	4
D4	Self Development (CSU Area E) (4 units in Support) ¹	0
Total units		36

¹ Required in Support; also satisfies GE

BS Manufacturing Engineering

Program Learning Outcomes

1. An ability to apply knowledge of mathematics, science, and engineering (includes proficiency in materials)
2. An ability to design and conduct experiments, as well as to analyze and interpret data (includes manufacturing laboratory or facility experience, the ability to measure manufacturing process variables and develop technical inferences about the process)
3. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (includes proficiency in manufacturing processes, the ability to design manufacturing processes that result in products that meet specific material and other requirements; proficiency in process, assembly and product engineering, the ability to design products and the equipment, tooling, and environment necessary for their manufacture; and proficiency in manufacturing systems design, the ability to analyze, synthesize, and control manufacturing operations using statistical methods)
4. An ability to function on multidisciplinary teams
5. An ability to identify, formulate, and solve engineering problems
6. An understanding of professional and ethical responsibility
7. An ability to communicate effectively

8. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context (includes manufacturing competitiveness, of the ability to create competitive advantage through manufacturing planning, strategy, quality, and control)
9. A recognition of the need for, and an ability to engage in life-long learning
10. A knowledge of contemporary issues
11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Degree Requirements and Curriculum

In addition to the program requirements listed on this page, students must also satisfy requirements outlined in more detail in the Minimum Requirements for Graduation (p. 32) section of this catalog, including:

- 60 units of upper division courses
- 2.0 GPA
- Graduation Writing Requirements (GWR)
- U.S. Cultural Pluralism (USCP)

Note: No major or support courses may be taken as credit/no credit.

MAJOR COURSES

IME 101	Introduction to Industrial and Manufacturing Engineering	1
IME 140	Graphics Communication and Modeling	2
IME 141	Manufacturing Processes: Net Shape	1
IME 142	Manufacturing Processes: Materials Joining	2
IME 144	Introduction to Design and Manufacturing	4
IME 156	Basic Electronics Manufacturing	2
IME 223	Process Improvement Fundamentals	4
IME 314	Engineering Economics	3
IME 327	Test Design and Analysis in Manufacturing Engineering	4
IME 330	Fundamentals of Manufacturing Engineering	4
IME 335	Computer-Aided Manufacturing I	4
IME 342	Manufacturing Systems Integration	4
IME 356	Manufacturing Automation	4
IME 417	Supply Chain and Logistics Management	4
IME 418	Product-Process Design	4
IME 430	Quality Engineering	4
IME 450	Manufacturing Process and Tool Engineering	4
IME 481	Senior Project Design Laboratory I	2
IME 482	Senior Project Design Laboratory II	3

Technical Electives^{2, 3, 4, 5, 6}

Select from the following:		14
AERO 300	Aerospace Engineering Analysis	
AERO 301	Aerothermodynamics I	
AERO 302	Aerothermodynamics II	
AERO 304	Experimental Aerothermodynamics	
AERO 320	Fundamentals of Dynamics and Control	
AG/ISLA/ EDES/ENGR/ SCM/UNIV 350	The Global Environment	
BMED 212	Introduction to Biomedical Engineering Design	

BMED 310	Biomedical Engineering Measurement and Analysis	IT 371	Supply Chain Management in Manufacturing and Services	
BMED 410	Biomechanics	IT 406	Industrial Sales	
BMED 420	Principles of Biomaterials Design	IT 407	Applied Business Operations	
BUS 310	Introduction to Entrepreneurship	IT 428	Commercialization of New Technologies	
BUS 311	Managing Technology in the International Legal Environment	MATE 310	Noncrystalline Material Systems	
BUS 346	Principles of Marketing	MATE 330	Composite Materials Systems	
BUS 488	Planning and Managing New Ventures	MATE 340	Electronic Materials Systems	
CE 207	Mechanics of Materials II	MATE 350	Structural Materials Systems	
EE 361	Electronics Laboratory	MATE 360	Metallurgical Materials Systems	
EE 434	Automotive Engineering for a Sustainable Future	MATE 410	Nanoscale Engineering	
IME 301	Operations Research I	MATE 430	Micro/Nano Fabrication	
IME 303	Project Organization and Management	MATE 435	Microfabrication Laboratory	
IME 305	Operations Research II	MATE 440	Welding Metallurgy and Joining of Advanced Materials	
IME 312	Data Management and System Design	MATE 445	Joining of Advanced Materials Laboratory	
IME 319	Human Factors Engineering	MATH 344	Linear Analysis II	
IME/HNRS 322	Leadership and Project Management	MATH 350	Mathematical Software	
IME 336	Computer-Aided Manufacturing II	ME 305	Introduction to Mechatronics	
IME 351	Advanced Material Removal Process Design	ME 318	Mechanical Vibrations	
IME 401	Sales Engineering	ME 326	Intermediate Dynamics	
IME 408	Systems Engineering	ME 328	Introduction to Design	
IME 409	Economic Decision Systems	ME 341	Fluid Mechanics I	
IME 410	Production Planning and Control Systems	ME 350	Heat Transfer	
IME 416	Automation of Industrial Systems	ME 405	Mechatronics	
IME 420	Simulation	ME 412	Composite Materials Analysis and Design	
IME 421	Manufacturing Organizations	ME 415	Energy Conversion	
IME 427	Design of Experiments	SUPPORT COURSES		
IME 428	Engineering Metrology	BIO 213	Life Science for Engineers	4
IME 429	Ergonomics Laboratory	& BMED 213	and Bioengineering Fundamentals (B2) ¹	
IME 435	Reliability for Design and Testing	CE 204	Mechanics of Materials I	3
IME 441	Engineering Supervision I	CHEM 124	General Chemistry for Physical Science and Engineering I (B3/B4) ¹	4
IME 442	Engineering Supervision II	CHEM 125	General Chemistry for Physical Science and Engineering II	4
IME 443	Facilities Planning and Design	CSC 232	Computer Programming for Scientists and Engineers	3
IME 457	Advanced Electronic Manufacturing	EE 201	Electric Circuit Theory	3
IME/MATE 458/CPE 488	Microelectronics and Electronics Packaging	EE 251	Electric Circuits Laboratory	1
IME 470	Selected Advanced Topics	EE 321	Electronics	3
IME 471	Selected Advanced Laboratory	ENGL 149	Technical Writing for Engineers (A3) ¹	4
IME/AERO 510	Systems Engineering I	MATE 210	Materials Engineering	3
IME/AERO 511	Systems Engineering II	MATE 215	Materials Laboratory I	1
IME 542	Applied Reliability Engineering	MATH 141	Calculus I (B1) ¹	4
IME 543	Applied Human Factors	MATH 142	Calculus II (B1) ¹	4
IME 556	Technological Project Management	MATH 143	Calculus III (Add'l Area B) ¹	4
IME 577	Engineering Entrepreneurship	MATH 241	Calculus IV	4
IT 326	Product Design and Development	MATH 244	Linear Analysis I	4
IT 329	Industrial Materials	ME 211	Engineering Statics	3
IT 330	Packaging Fundamentals	ME 212	Engineering Dynamics	3
IT 341	Packaging Polymers and Processing	ME 302	Thermodynamics I	3
		PHYS 132	General Physics II	4

PHYS 133	General Physics III	4
PHYS 141	General Physics IA (Add'l Area B) ¹	4
STAT 321	Probability and Statistics for Engineers and Scientists (B6) ¹	4
GENERAL EDUCATION (GE)		
(See GE program requirements below.)		40
FREE ELECTIVES		
Free Electives		0
Total units		192

- ¹ Required in Support; also satisfies GE
- ² The courses selected to satisfy this requirement may not be used to satisfy other major, support, or general education requirements (no double counting of coursework).
- ³ At least 10 units must be upper level (300-level or above) engineering or computer science courses.
- ⁴ A maximum of 4 units of technical electives may be upper level (300-level or above) courses from outside of the College of Engineering or lower level (100 or 200 level) engineering or computer science courses.
- ⁵ Students may take other 300 level or above courses not in the list subject to the approval by advisor and IME department chair. Consultation with advisor is recommended prior to selecting technical electives; bear in mind your selections may impact pursuit of post-baccalaureate studies and/or goals.
- ⁶ IME 400 and IME 500 require a special problems form and no more than 4 total units are allowed.

General Education (GE) Requirements

- 72 units required, 32 of which are specified in Major and/or Support.
- See the complete GE course listing (p. 32).
- Minimum of 8 units required at the 300 level.

Area A	Communication	
A1	Expository Writing	4
A2	Oral Communication	4
A3	Reasoning, Argumentation and Writing (4 units in Support) ¹	0
Area B	Science and Mathematics	
B1	Mathematics/Statistics (8 units in Support) ¹	0
B2	Life Science (4 units in Support) ¹	0
B3	Physical Science (4 units in Support) ¹	0
B4	One lab taken with either a B2 or B3 course	
B6	Upper-division Area B (4 units in Support) ¹	0
Additional Area B units (8 units in Support) ¹		0
Area C	Arts and Humanities	
C1	Literature	4
C2	Philosophy	4
C3	Fine/Performing Arts	4
C4	Upper-division elective	4
Area D/E	Society and the Individual	
D1	The American Experience (Title 5, Section 40404 requirement) (40404)	4

D2	Political Economy	4
D3	Comparative Social Institutions	4
D4	Self Development (CSU Area E)	4
Total units		40

¹ Required in Support; also satisfies GE

MS Industrial Engineering

The MS IE program has flexible curriculum allowing the student a wide choice in course selection. The program requires a minimum 45 quarter credits of course work in the 400 or 500 level. Of the 45 units, 22 are technical electives. Student can choose technical elective courses from the Industrial and Manufacturing Engineering (IME) department as well as outside the IME department. Flexibility is emphasized so that the student and his/her advisor can structure a degree plan tailored to the individual needs of the student. Only those letter-graded courses count toward satisfying the total unit requirement for the degree. Courses on a credit/no credit basis are not allowed in the formal study plan. No audit credits are permitted.

The MS IE program requires a thesis; the student's thesis topic must be approved by his/her graduate committee, consisting of three committee members. Both an oral defense and a written thesis are required. The thesis will be reviewed by the Graduate Education Office and published at the Digital Commons.

Required Courses

IME 503	Applied Statistical Methods in Engineering ¹	4
IME 507	Graduate Seminar	2
IME 556	Technological Project Management ²	4
IME 580	Manufacturing Systems ³	4
IME 599	Design Project (Thesis)	9

Approved Electives

Select from the following ⁴		22
IME 417	Supply Chain and Logistics Management	
IME 418	Product-Process Design	
IME 420	Simulation	
IME 427	Design of Experiments	
IME 430	Quality Engineering	
IME/MATE 458/CPE 488	Microelectronics and Electronics Packaging	
IME 470	Selected Advanced Topics	
IME 500	Individual Study (up to a maximum of 6 units)	
IME/AERO 510	Systems Engineering I	
IME/AERO 511	Systems Engineering II	
IME 541	Advanced Operations Research	
IME 542	Applied Reliability Engineering	
IME 543	Applied Human Factors	
IME 544	Advanced Topics in Engineering Economy	
IME 545	Advanced Topics in Simulation	
IME 570	Selected Advanced Topics	
IME 577	Engineering Entrepreneurship	
STAT 416	Statistical Analysis of Time Series	