

ENGINEERING SCIENCES PROGRAMS

Major in Engineering Biology

Coordinator: *Fatma Mili (Engineering)*

Advisers: *Mohammad Siadat (Engineering), Shaleish Lal (Biological Sciences)*

Steering Committee: *Arik Dvir (Biological Sciences), Mohammad Siadat (Engineering), Shaleish Lal (Biological Sciences), Charles Lindemann (Biological Sciences), Fatma Mili (Engineering), Lian Xiang Yang (Engineering)*

The program in engineering biology, offered jointly by the School of Engineering and Computer Science and the College of Arts and Sciences, leads to the Bachelor of Science degree. It combines training in biology with depth in either computation or engineering.

To earn the degree of Bachelor of Science with a major in engineering biology, students must complete a minimum of 130 credits, satisfy writing requirement (also see *Undergraduate degree requirements*) and meet the following requirements:

	Credits
General Education	24
Core Courses	
MTH 154-155	8
APM 255	4
MTH 254	4
STA 226	4
	<u>20</u>
PHY 151-152	8
	8
CHM 157-158	10
CHM 201	4
	<u>14</u>
BIO 111-113	8
BIO 116	1
BIO 321	4
	4
BIO 325	4
BIO 341	4
	<u>21</u>
EGR 120	1
EGR 141	1

	Science	4
EGR 240	Introduction to Electrical and Computer Engineering	4
EGR 250	Introduction to Thermal Engineering	4
EGR 280	Design and Analysis of Electromechanical Systems	<u>4</u>
		17
EGB 390	Introduction to Engineering Biology	3
EGB 490	Research Project/Capstone Design	<u>3</u>
		6
Core Subtotal		<u>86</u>

**These course sequences satisfy the general education requirements for the formal reasoning, natural science/technology and knowledge applications categories.*

Professional Subjects (Choose one of 5 tracks) see below	15-16
Free Electives ¹	4-5
Grand Total²	130

Professional Track 1: Bioinformatics

Required: (Choose four courses including BIO 443 and CSE 461)

CSE 230	Object Oriented Computing I	4
CSE 361	Design and Analysis of Algorithms	4
BIO 443	Functional Genomics and Bioinformatics	4
CSE 345	Database Design and Implementation	4
CSE 461	Bioinformatics	<u>4</u>
		16

¹Students can use the free electives credit to satisfy the writing requirements.

²The general CAS distribution requirement does not apply to this program.

Professional Track 2: Biomedical and Biophysical Engineering**

Required:

PHY 325	Biological Physics	4
ME 361	Mechanics of Materials	4
ME 456	Energy Systems Analysis and Design or PHY 421	4
	Thermodynamics	4
ME 461	Analysis and Design of Mechanical Structures (requires ME 361)	<u>4</u>
		16

Professional Track 3: Computational Biology

Required:

MTH 275	Linear Algebra	4
APM 405	Special Topics	4
BIO 482	Evolutionary Biology or BIO 483 Community and Population Biology	3

Electives: (Choose one)	4
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APM 357	Elements of Partial Differential Equations	4
APM 433	Numerical Methods	4
APM 434	Applied Numerical Methods: Matrix Methods	4
APM 455	Intermediate Ordinary Differential Equations	<u>4</u>
		15

Professional Track 4: Electronic Devices/Signal Analysis/Bio-sensors**

Required:

ECE 276	Circuits and Systems	4
ECE 327	Electronic Circuits and Devices	4
CSE 465	Intro to Micro- and Nano-technology	4
CHM 428	Intro to Bio-instrumentation/Bio-sensors	<u>4</u>
		16

Highly Recommended:

In addition to the required courses, students are strongly encouraged to consult their faculty adviser for advice on taking more advanced courses related to this emerging track.

Professional Track 5: Molecular Engineering Biology

Choose four (Choice must include BIO 319, BIO 423 and BIO 441):

PHY 325	Biological Physics	4
BIO 309	Biology of the Cell	4
BIO 319	General Microbiology	4
BIO 323	Developmental Biology	4
BIO 423	Immunology	4
BIO 441	Microbial Biotechnology	<u>4</u>
		16

Performance requirements

In addition to the previously stated requirements, satisfactory completion of the program requires an average grade of at least 2.00 in the courses taken to satisfy the engineering, chemistry, and mathematics and physics requirements.

Major in engineering chemistry

Coordinators: *Ching L. Ko (engineering), Dagmar Cronn (chemistry)*

The program in engineering chemistry, offered jointly by the School of Engineering and Computer Science and the College of Arts and Sciences, leads to the Bachelor of Science degree. It provides for intensive study in chemistry, along with basic preparation in engineering.

To earn the degree of Bachelor of Science with a major in engineering chemistry, students must complete a minimum of 128 credits, satisfy writing requirement (also see *Undergraduate degree requirements*) and meet the following requirements:

	Credits
General education	24
Mathematics and physics	
MTH 154-155	Calculus 8
APM 255	Introduction to Differential Equations with Matrix Algebra 4
MTH 254	Multivariable Calculus 4
PHY 151-152	Introductory Physics <u>8</u>
	24

Chemistry

CHM 157-158	General Chemistry (or CHM 167-168)	8-10
	(or CHM 162-163)	
CHM 234-235	Organic Chemistry	8
CHM 237	Organic Chemistry Laboratory	2
CHM 325	Analytical Chemistry	4
CHM 342-343	Physical Chemistry	8
CHM 348	Physical Chemistry Laboratory	2
CHM 471	Structure and Synthesis of Polymers	3
Plus one lecture or laboratory course (two or three credits) above CHM 400		<u>2 (3)</u>
		37(40)

Engineering

EGR 120	Engineering Graphics and CAD	1
EGR 141	Computer Problem Solving in Engineering and Computer Science	4
EGR 240	Introduction to Electrical and Computer Engineering	4
EGR 250	Introduction to Thermal Engineering	4
EGR 260	Introduction to Industrial and Systems Engineering	4
EGR 280	Design and Analysis of Electromechanical Systems	4
ME 331	Introduction to Fluid and Thermal Energy Transport	<u>4</u>
		25

Plus 8 credits from:

ME 438	Fluid Transport (4)	
ME 448	Thermal Energy Transport (4)	
ME 456	Energy Systems Analysis and Design (4)	
ME 457	Internal Combustion Engines I (4)	
ME 482	Fluid and Thermal Systems Design (4)	
ECE 431	Automatic Control Systems (4)	
		<u>8</u>

Capstone Course

EGR 491 or CHM 491		3
Free electives (may be used for writing requirement)		<u>4 (7)</u>
		Total 128

Performance requirements

In addition to the previously stated requirements, satisfactory completion of the program requires an average grade of at least 2.00 in the courses taken to satisfy the engineering, chemistry, and mathematics and physics requirements.

Major in Engineering Physics

Coordinators: *Hoda Abdel-Aty-Zohdy (engineering), Andrei Slavin (physics)*

The program in engineering physics is offered jointly by the School of Engineering and Computer Science and the College of Arts and Sciences. This program blends the pure and applied, the theoretical and practical aspects of scientific knowledge into a meaningful educational experience. Through the university's cooperative education program, engineering physics students may opt to combine a relevant work experience with their formal education. To earn the degree of Bachelor of Science with a major in engineering physics, students must complete a minimum of 128 credits, demonstrate writing proficiency (see *Undergraduate degree requirements*) and meet the following requirements:

	Credits
General education	24
Mathematics and sciences	
MTH 154-155 Calculus	8
MTH 254 Multivariable Calculus	4
APM 255 Introduction to Differential Equations with Matrix Algebra	4
CHM 143 Chemical Principles (or CHM 157 or 162)	4
PHY 151-152 Introductory Physics	8
PHY 158 General Physics Laboratory	2
PHY 317 Modern Physics Laboratory	2
PHY 351 Intermediate Theoretical Physics	4
PHY 361 Mechanics I	4
PHY 371 Foundations of Modern Physics	4
Another course in physics in addition to any required in options below, chosen from:	
PHY 331 Optics (4)	
PHY 366 Vibrations and Waves (4)	
PHY 381 Electricity and Magnetism I (4)	
PHY 472 Quantum Mechanics I (4)	
	<hr/> 48
Engineering	
EGR 120 Engineering Graphics and CAD	1
EGR 141 Computer Problem Solving in Engineering and Computer Science	4
EGR 240 Introduction to Electrical and Computer Engineering	4
EGR 250 Introduction to Thermal Engineering	4
EGR 260 Introduction to Industrial and Systems Engineering	4
EGR 280 Design and Analysis of Electromechanical Systems	4
ECE 276 Circuits and Systems	4
ECE 327 Electronic Circuit and Devices	4
EGR 491 or PHY 490 Capstone Design / Independent Research	<hr/> 3
	32
Professional options	
(The following two options are offered as typical. Select 12 credits from one of these. Students with different interests can construct different options in consultation with the program coordinators.)	
Solid state physics and technology option	
ECE 384 Electronic Materials and Devices	4
PHY 472 Quantum Mechanics I	4
Design elective, chosen from:	4
ECE 378 Digital Logic and Microprocessor Design (4)	
ECE 426 Advanced Electronic Circuit Designs (4)	
ECE 437 Communication Systems (4)	
ECE 470 Microprocessors-based Systems Design (4)	
ECE 487 Integrated Electronics (4)	
	<hr/> 12
Applied mechanics option	
PHY 366 Vibrations and Waves	4
ME 322 or 361 Engineering Mechanics or Mechanics of Materials	4
Design elective, chosen from:	4
ME 456 Energy Systems Analysis and Design (4)	
ME 461 Analysis and Design of Mechanical Structures (4)	

ME 482	Fluid and Thermal Systems Design (4)
ME 486	Mechanical Systems Design (4)
ME 487	Mechanical Computer-Aided Engineering(4)

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Technical electives, choose 6 to 8 credits from:

MTH 275	Linear Algebra (4)
APM 263	Discrete Mathematics (4)
PHY 318	Nuclear Physics Laboratory (2)
PHY 331	Optics (4)
PHY 366	Vibrations and Waves (4)
PHY 372	Nuclear Physics (4)
PHY 381	Electricity and Magnetism I (4) or
PHY 418	Modern Optics Laboratory (2)
PHY 472	Quantum Mechanics I (4)
PHY 482	Electricity and Magnetics II (4)
ECE 352	Electromagnetics and Electromechanisms (4)
ECE 378	Digital Logic and Microprocessor Design (4)
ECE 384	Electronic Materials and Devices (4)
ME 331	Introduction to Fluid and Thermal Energy Transport (4)
ME 361	Mechanics of Materials (4)
Any 400-level ECE, ME or ISE courses (4-8)	

 6-8

Free electives (may be used to satisfy writing requirement)

4-6

 Total 128

Performance requirements

In addition to the previously stated requirements, satisfactory completion of the program requires an average grade of at least 2.00 in the engineering and computer science courses and also in the mathematics and science courses taken to meet program requirements.

Course Offerings

Courses offered through the School of Engineering and Computer Science carry the following designations: information technology courses, CIT; computer science and engineering courses, CSE; electrical and computer engineering courses, ECE; industrial and systems engineering courses, ISE; mechanical engineering courses, ME. Courses offered under the general title of engineering are listed under EGR. For some of the courses, the semester(s) in which they are usually offered is indicated at the end of the course description. However, this is subject to change. To register for 300- and 400-level courses, students must have attained major standing.

ENGINEERING

EGR 120 Engineering Graphics and CAD (1)

An introduction to the techniques for creating solid models of engineering designs. Topics include three-dimensional modeling of parts and assemblies, visualization, orthographic project views and layouts, auxiliary, sectional, and cutout views, exploded views, dimensioning and tolerancing, bill of materials, and computer-generated design documentation. Offered fall, winter.