

Biosystems Engineering

Col of Engineering

Biosystems engineering provides an essential link between the biological sciences and the engineering profession. This linkage is necessary for the development of production and processing systems involving biological materials that preserve our natural resource base. Students have the latitude to develop an area of specialization relating to environmental engineering, biotechnology, food processing, machine systems, or controlled environment engineering. The curriculum is also ideal preparation for those students wanting to pursue a graduate or professional degree in biomedical engineering or veterinary medicine through the pre-biomedical and pre-veterinary medicine options.

The curriculum in biosystems engineering is administered jointly by the Col of Engineering and the Col of Agriculture. Graduates earn the Bachelor of Science in Biosystems Engineering degree.

Admission to the degree program is selective. Students should refer to the UK *Bulletin* for general information concerning admission and graduation requirements.

Degree Requirements

In addition to fulfilling UK Core and Col of Engineering requirements, students must complete the biosystems engineering curriculum. The following curriculum meets the requirements for the B.S. degree.

Freshman Year

First Semester	Hours
EGR 101 Engineering Exploration I Δ §	1
EGR 102 Fundamentals of Engineering Computing	2
CHE 105 GenColChem I CHEM 1351 or PHY 231 GenUnivPhy I PHYS 2404 ●	4
PHY 241 General University Physics Laboratory PHYS 2404 †	1
CIS/WRD 110 Composition and Communication I ENG 1301	3
MA 113 Calculus I MATH 1402	4
Second Semester	
EGR 103 Engineering Exploration II Δ	2
CIS/WRD 111 Composition and Communication II ENG 1302	3
MA 114 Calculus II MATH 2305	4
PHY 231 Gen Univ Phy PHYS 2404 or CHE 105 Gen Col Chem I CHEM 1351 ●	4
UK Core (Social Sciences)	3

Sophomore Year

First Semester	Hours
BAE 201 Economic Analysis for Biosystems	2
BIO 148 Introductory Biology I BIO 2306	3
MA 213 Calculus III MATH 2306	4
CHE 107 Gen Col Chemistry II CHEM 1352	3
UK Core (Humanities)	3
CE 106 Computer Graphics and Communication ENGR 1306	3
Second Semester	
BAE 202 Statistical Inferences for Biosystems Engineering	3
MA 214 Calculus IV MATH 3301	3
ME 220 Engineering Thermodynamics I	3
EM 221 Statics	3
PHY 232 General University Physics PHYS 2405	4
PHY 242 General University Physics Laboratory PHYS 2405	1

Students taking **ENG 1301** and **1302** should also take one of the following:
CART 1300, 1340 or 1341.

Junior Year

First Semester	Hours
CE 341 Introduction to Fluid Mechanics	4
EE 305 Electrical Circuits and Electronics	3
EM 313 Dynamics	3
BIO 152 Principles of Biology II BIO 2305	3
WRD 204 Technical Writing ***	3
Second Semester	
ME 325 Elements of Heat Transfer	3
BAE 305 DC Circuits and Microelectronics	3
EM 302 Mechanics of Deformable Solids	3
Biological Science Elective	3
Biosystems Core Elective*	3

Senior Year

First Semester	Hours
BAE 402 Biosystems Engineering Design I	2
BAE 400 Senior Seminar	1
Biosystems Core* or Technical Electives**	3
Biosystems Core* or Technical Electives**	3
Biosystems Core* or Technical Electives**	3
Technical Electives**	3
UK Core (Citizenship – USA)	3
Second Semester	
BAE 403 Biosystems Engineering Design II	2
ME 340 Introduction to Mechanical Systems	3
Biosystems Core* or Technical Electives**	3
Biosystems Core* or Technical Electives**	3
Supporting Elective†	3
UK Core (Global Dynamics)	3

*A minimum of 9 hours are required from the biosystems engineering core courses: BAE 417 Design of Machine Systems, BAE 427 Structures and Environment Engineering, BAE 437 Land and Water Resources Engineering, and BAE 447 Bioprocess Engineering Fundamentals.

**A minimum of 12 hours are to be taken in addition to the 9 core hours selected by the student. The technical electives allow the student an opportunity to concentrate or gain depth in one or more of the various specialty areas of biosystems engineering. The technical electives must be selected from the courses listed below and approved by the student's academic advisor. Other courses may be considered, each on its individual merit.

***Graduation Composition and Communication Requirement (GCCR) course.

Approved technical electives: BAE 435G, 438G, 450, 503, 504, 505, 506, 515, 517, 532, 536, 537, 538, 541, 549, 580, 599; BCH 401G; BME 301, 481G, 488, 501, 530, 599; CE 211, 351, 451, 461G, 471G, 525, 551; CHE 230, 236; CME 599; EE 402G; FSC 434G, 530, 536, 538; ME 321, 344, 440, 501, 503, 513, 532; PGY 412G; NRE 556; GEO 451G; EES 530, 585; EGR 599.

†Supporting electives are any University course excluding more elementary versions of required courses such as pre-calculus math or PHY 211.

Δ Both classes must be taken to fulfill UK Core: Arts & Creativity requirement.

● Based on advisor consult

§ Transfer students who declare a major will take EGR 112 Engineering Exploration for Transfer Students in place of EGR 101.

‡ Only if enrolled in PHY 231

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Chemical Engineering

Col of Engineering

A foundation in mathematics, chemistry, and physics is required for the study of chemical engineering. Fundamental principles related to the transformation of matter and energy are developed in subjects including thermodynamics, fluid flow, separations, heat and mass transfer, reactor design, and chemical process design. Undergraduate electives are available in biopharmaceutical engineering, energy and fuels, environmental engineering, and materials engineering and nanotechnology. A program is also available to fulfill pre-medical requirements simultaneously with requirements for the B.S. in chemical engineering.

Admission to the degree program is selective. Students should refer to the UK *Bulletin* for general information concerning admission and graduation requirements.

Degree Requirements

In addition to fulfilling UK Core and Col of Engineering requirements, students must complete the chemical engineering curriculum. The following curriculum meets the requirements for the B.S. degree.

Freshman Year

First Semester	Hours
EGR 101 Engineering Exploration I Δ §	1
EGR 102 Fundamentals of Engineering Computing	2
CHE 105 Gen Col Chem I CHEM 1351 or PHY 231 GenUnivPhy I PHYS 2404 ●4	4
CHE 111 Laboratory to Accompany General Chemistry I CHEM 1251	1
CIS/WRD 110 Composition and Communication I ENG 1301	3
MA 113 Calculus I MATH 1402	4
Second Semester	
EGR 103 Engineering Exploration II Δ	2
CIS/WRD 111 Composition and Communication II ENG 1302	3
MA 114 Calculus II MATH 2305	4
PHY 231 Gen Univ Phy PHYS 2404 or CHE 105 Gen Col Chem I CHEM 1351 ●4	4
UK Core (Social Sciences)	3

Sophomore Year

First Semester	Hours
CME 200 Process Principles	3
MA 213 Calculus III MATH 2306	4
CHE 107 General Col Chemistry II CHEM 1352	3
CHE 113 Laboratory to Accompany General Chemistry II CHEM 1252	2
MSE 201 Materials Science	3
UK Core (Humanities)	3
Second Semester	
CME 320 Engineering Thermodynamics	4
CME 220 Computational Tools in Chemical Engineering	3
MA 214 Calculus IV MATH 3301	3
PHY 232 General University Physics PHYS 2405	4
STA 381 Engineering Statistics A Conceptual Approach	3

Students taking ENG 1301 and 1302 should also take one of the following:
CART 1300, 1340 or 1341.

Junior Year

First Semester	Hours
CME 415 Separation Processes	3
CHE 446G Physical Chemistry for Engineers	3
CME 330 Fluid Mechanics	3
WRD 204 Technical Writing *	3
CHE 230 Organic Chemistry I	3
CHE 231 Organic Chemistry Laboratory I	1
Second Semester	
CME 006 The Engineering Profession (Junior and Senior)	0
CME 420 Process Modeling in Chemical Engineering	3
CME 425 Heat and Mass Transfer	4
CME 432 Chemical Engineering Laboratory I	2
CHE 232 Organic Chemistry II CHEM 3302	3
Engineering/Science Elective† MATH 3307	3
UK Core (Citizenship – USA)	3

Senior Year

First Semester	Hours
CME 006 The Engineering Profession (Junior and Senior)	0
CME 470 Professionalism, Ethics and Safety	2
CME 433 Chemical Engineering Laboratory II	3
CME 455 Chemical Engineering Process Design I	3
CME 550 Chemical Reactor Design	3
UK Core (Global Dynamics)	3
Engineering/Science Elective†	3
Second Semester	
CME 006 The Engineering Profession (Junior and Senior)	0
CME 456 Chemical Engineering Process Design II	4
CME 462 Process Control	3
Engineering/Science Elective†	3
Engineering/Science Elective†	3
Supportive Elective **	3

Δ Both classes must be taken to fulfill UK Core: Arts & Creativity requirement.

§ Graduation Composition and Communication Requirement (GCCR) course.

** Supportive Elective (3 credits) can be any course that carries Col credit and is not a more elementary version of a required course. The student completing 3 co-op tours (EGR 399) may count the co-op experience toward the supportive elective.

● Based on advisor consult

§ Transfer students who declare a major will take EGR 112 Engineering Exploration for Transfer Students in place of EGR 101.

† Engineering/Science Elective Structure. Students must select four courses as follows:

1. Chemical engineering elective (CME 395, 404G, 505, 515, 542, 554, 556, 580, 599) [CME 395 (3 credits) can be used to satisfy only one elective Requirement]

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Chemical Engineering

Col of Engineering

2. *Science/math elective (totaling three or more credit hours**) that is not a more elementary version of a required course. [Students may combine multiple qualifying courses that total 3 credits (e.g. pre-medical students may wish to combine PHY 241, 242 and CHE 233)]*
 - a. *Math (MA 321, 322, 416G, 432G, 433G, 471G, 481G)*
 - b. *Chemistry (CHE 226, 250, 510 and above)Biology (BIO 148 and above)*
 - c. *Physics (PHY 241 and above)*
 - d. *Other courses by approval of Director of Undergraduate Studies*
3. *Engineering elective (level 300 and above) that does not significantly duplicate content in a core chemical engineering course (e.g. ME 330) OR a CME Elective (CME 395 and above).*
4. *Chemical engineering elective (CME 395 and above) OR one engineering elective (level 300 and above) OR one science/math elective as described above.*

Civil Engineering

Col of Engineering

A civil engineering curriculum provides a strong foundation for entry into the profession or graduate school. Major areas include construction engineering and project management, environmental engineering, geotechnical engineering, materials engineering, structural engineering, transportation engineering, and water resources engineering.

Admission to the degree program is selective. Students should refer to the UK *Bulletin* for general information concerning admission and graduation requirements.

Degree Requirements

The following curriculum meets the requirements for a B.S. in Civil Engineering, provided the student satisfies UK Core and Col of Engineering requirements.

Freshman Year

First Semester	Hours
EGR 101 Engineering Exploration I Δ §	1
EGR 102 Fundamentals of Engineering Computing	2
CHE 105 Gen Col Chem I CHEM 1351 or PHY 231 Gen Univ Phy PHYS 2404 ●	4
PHY 241 Gen Univ Phy Lab PHYS 2404 ‡	1
CIS/WRD 110 Composition and Communication I ENG 1301	3
MA 113 Calculus I MATH 1402	4
Second Semester	
EGR 103 Engineering Exploration II Δ	2
CIS/WRD 111 Composition and Communication II ENG 1302	3
MA 114 Calculus II MATH 2305	4
PHY 231 Gen Univ Phy PHYS 2404 or CHE 105 GenColChem I CHEM 1351 ●	4
UK Core (Humanities)	3

Sophomore Year

First Semester	Hours
CE 211 Surveying	4
CHE 107 General Col Chemistry II CHEM 1352	3
EM 221 Statics	3
MA 213 Calculus III MATH 2306	4
CE 106 Computer Graphics and Communication ENGR 1306	3
Second Semester	
EM 302 Mechanics of Deformable Solids	3
MNG 303 Deformable Solids Laboratory	1
MA 214 Calculus IV MATH 3301	3
PHY 232 General University Physics PHYS 2405	4
PHY 242 General University Physics Laboratory PHYS 2405	1
STA 381 Engineering Statistics A Conceptual Approach	3

Students taking ENG 1301 and 1302 should also take one of the following:
CART 1300, 1340 or 1341.

Junior Year

First Semester	Hours
WRD 204 Technical Writing (GCCR)*	3
EES 220 Principles of Physical Geology	4
CE 303 Introduction to Construction Engineering	3
CE 341 Introduction to Fluid Mechanics	4
CE 381 Civil Engineering Materials I	3
Second Semester	
CE 331 Transportation Engineering	3
CE 351 Introduction to Environmental Engineering	3
CE 382 Structural Analysis	3
Engineering Science Elective [1]	3
Math Elective or Science Elective [2] MATH 3307	3
UK Core (Social Sciences)	3

Senior Year

First Semester	Hours
CE 461G Water Resources Engineering	4
CE 471G Soil Mechanics	4
CE 48X Structures Elective [3]	3
CE Design Elective [4]	3
UK Core (Citizenship – USA)	3
Second Semester	
CE401 Seminar	1
CE 429 Civil Engineering Systems Design	3
CE Design Elective [4]	3
Technical Elective [5]	3
Supportive Elective [6]	3
UK Core (Global Dynamics)	3

[1] To be chosen from ME 220 or EM 313.

[2] Math or Science Elective Options: MA 321, MA 322, MA 416G, MA 432G, BIO 208, CHE 230, CHE 236, EE 305, GEO 409, EES 550, EES 585, MNG 551, or the other half of the Engineering Science Elective in [1]. NOTE: MA 322 is required for a math minor.

[3] To be selected from: CE 482 or CE 486G.

[4] Students are required to select two design electives from different areas. Choose from: CE 508, CE 531 or CE 533, CE 534, CE 549, CE 551, CE 579, CE 589. **Design elective courses are typically taught once a year.**

[5] Technical Elective is chosen from any of the courses at the 300-level or above that carry a CE prefix and in which a student is qualified to enroll, exclusive of required courses. **Engineering elective courses are typically taught once a year.**

[6] Supportive elective is to be chosen from any University course, excluding a more elementary version of a required course, such as precalculus mathematics or PHY 211. However, each CE area has at least one recommendation for the supportive elective. Please review the Optional Concentration section in the Civil Engineering Undergraduate Handbook. The supportive elective can be taken pass-fail.

Δ Both classes must be taken to fulfill UK Core: Arts & Creativity requirement.

● Based on advisor consult

‡ Only if enrolled in PHY 231

*Graduation Composition and Communication Requirement (GCCR) course.

§ Transfer students who declare a major will take EGR 112 Engineering Exploration for Transfer Students in place of EGR 101.

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Computer Engineering

Col of Engineering

Computer Engineers shape the way people work, play, live and learn in the modern world and develop the infrastructure and devices people can't imagine living without. Computer Engineering is a dynamic and rewarding field that draws upon Electrical Engineering and Computer Science. Computer Engineers solve today's most challenging technology problems by applying their expertise in both hardware and software systems. Leveraging everything from the world's smallest micro-controllers to the largest server farms on the planet, Computer Engineers have revolutionized modern entertainment, medicine, telecommunications, transportation, and Information Technology. Computer Engineering graduates find employment in positions requiring Computer Science, Electrical Engineering or Computer Engineering expertise, are in high demand in virtually all industries, and are among the highest compensated specialties in engineering. Admission to the degree program is selective. Students should refer to the UK *Bulletin* for general information concerning admission and graduation requirements.

Degree Requirements

In addition to fulfilling UK Core and Col of Engineering requirements, students must complete the computer engineering curriculum. The following curriculum meets the requirements for the B.S. degree.

Freshman Year

First Semester	Hours
EGR 101 Engineering Exploration I Δ §	1
EGR 102 Fundamentals of Engineering Computing	2
PHY 231 Gen Univ Phy PHYS 2404 or CHE 105 Gen Col Chem I CHEM 1351 ●	4
PHY 241 Gen Univ Phy Lab PHYS 2404 ‡	1
CIS/WRD 110 Composition and Communication I ENG 1301	3
MA 113 Calculus I MATH 1402	4
Second Semester	
EGR 103 Engineering Exploration II Δ	2
CIS/WRD 111 Composition and Communication II ENG 1302	3
MA 114 Calculus II MATH 2305	4
CHE 105 Gen Col Chem I CHEM 1351 or PHY 231 Gen Univ Phy PHYS 2404 ●	4
CS 215 Introduction to Program Design, Abstraction, and Problem Solving Techniques	4

Sophomore Year

First Semester	Hours
MA 213 Calculus III MATH 2306	4
PHY 232 General University Physics PHYS 2405	4
PHY 242 General University Physics Laboratory PHYS 2405	1
CS 216 Introduction to Software Engineering Techniques	3
CPE 282 Digital Logic Design	4
Second Semester	
MA 214 Calculus IV MATH 3301	3
EE 211 Circuits I	4
CPE 287 Introduction to Embedded Systems	4
CS 270 Systems Programming	3
CS 275 Discrete Mathematics	4

Junior Year

First Semester	Hours
EE 223 AC Circuits	4
CS 315 Algorithm Design and Analysis	3
CPE 380 Microcomputer Organization	3
STA 381 Engineering Statistics A Conceptual Approach	3
UK Core (Humanities)	3

Second Semester

EE 421G Signals and Systems	3
EE 461G Introduction to Electronics	3
CPE 480 Advanced Computer Architecture**	3
CPE Elective	3
Technical Elective † MATH 3307	3
UK Core (Social Sciences)	3

Senior Year

First Semester	Hours
CPE 490 ECE Capstone Design I** †, ***	3
CPE Elective † †	3
Technical Elective †	3
Supportive Elective*	3
UK Core (Citizenship – USA)	3

Second Semester

CPE 491 ECE Capstone Design II** †	3
Hardware Elective ϕ	3
Software Elective θ	3
CPE Elective † †	3
UK Core (Global Dynamics)	3

*Supportive elective is to be chosen from any University courses, excluding more elementary versions of required courses, such as precalculus mathematics, MA 308, MA 310 or PHY 211.

**CPE480 is only taught in the spring semester. CPE490 is only taught in the fall semester. CPE491 is only taught in the spring semester.

***Graduation Composition and Communication Requirement (GCCR) course.

† Technical elective may be selected from upper-division engineering, mathematics, statistics, computer science, physics, or other technically-related fields excluding more elementary version of required courses. To be selected in consultation with academic advisor. If a student wishes to use CS 499 instead of CPE 490 and CPE 491 to fulfill the GCCR and senior design requirements, the student must receive approval from the DUS to select an additional technical elective that supports the proposed CS 499 project.

† † 400 level CS courses and 500 level CPE courses with emphasis in the computer engineering area and excluding EE 595. To be selected in consultation with academic advisor.

Δ Both classes must be taken to fulfill UK Core: Arts & Creativity requirement.

ϕ Hardware electives are senior level course in the CPE or EE disciplines and shall be selected from the following list and/or selected in consultation with academic advisor:

- EE 582 Hardware Description Languages and Programmable Logic
- CPE 584 Introduction of VLSI Design and Testing
- CPE 585 Fault Tolerant Computing
- CPE 586 Communication and Switching Networks

θ Software electives are senior level course in the CPE or CS disciplines and shall be selected from the following list and/or selected with academic advisor:

- CS 441G Compilers for Algorithmic Languages
- CS 471G Networking and Distributed Operating Systems
- CS 570 Modern Operating Systems
- CPE 588 Real-Time Digital Systems

● Based on advisor consult
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‡ Only if enrolled in PHY 231
Students taking ENG 1301 and 1302 should also take one of the following:
CART 1300, 1340 or 1341.

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Computer Science

Col of Engineering

The computer science program prepares students to identify computational problems in all areas of modern life, to design, implement, and analyze algorithmic solutions, and to build software for a variety of applications. Through required, elective and special topics courses students are exposed to the foundations and current practices of computing and algorithms, software engineering, programming languages, operating systems, graphics and multimedia, scientific computing and numerical analysis, databases, artificial intelligence and networks.

Admission to the degree program is selective. Students should refer to the UK *Bulletin* for general information concerning admission and graduation requirements.

Degree Requirements

In addition to satisfying UK Core requirements, each student completes the following:

Freshman Year

First Semester	Hours
EGR 101 Engineering Exploration I Δ §	1
EGR 102 Fundamentals of Engineering Computing	2
CHE 105 Gen Col Chem I CHEM 1351 or PHY 231 Gen Univ Phy PHYS 2404 ●	4
PHY 241 Gen Univ Phy Lab PHYS 2404 ‡	1
CIS/WRD 110 Composition and Communication I ENG 1301	3
MA 113 Calculus I MATH 1402	4

Second Semester

EGR 103 Engineering Exploration II Δ	2
CIS/WRD 111 Composition and Communication II ENG 1302	3
MA 114 Calculus II MATH 2305	4
PHY 231 Gen Univ Phy PHYS 2404 or CHE 105 GenColChem I CHEM 1351 ●	4
CS 215 Introduction to Program Design, Abstraction, and Problem Solving	4

Sophomore Year

First Semester	Hours
CS 216 Introduction to Software Engineering Techniques	3
EE 280 Design of Logic Circuits	3
MA 213 Calculus III MATH 2306	4
CS 275 Discrete Mathematics	4
UK Core (Social Sciences)	3

Second Semester

CS 270 Systems Programming	3
CS 315 Algorithm Design and Analysis	3
Technical Elective [T] MATH 3301	3
Science Elective [S]	3
UK Core (Humanities)	3

Students taking **ENG 1301** and **1302** should also take one of the following: **CART 1300, 1340** or **1341**.

Junior Year

First Semester	Hours
CS 371 Introduction to Computer Networking	3
CS/MA 321 Introduction to Numerical Methods or MA 322 Matrix Algebra MATH 3307	3
CS Elective [C]	3
CS Elective [C]	3
STA 381 Engineering Statistics: A Conceptual Approach	3

Second Semester

CS 375 Logic and Theory of Computing	3
CS Elective [C]	3
CS Elective [C]	3
Natural Science Elective [N]	3
Technical Elective [T]	3
UK Core (Citizenship – USA)	3

Senior Year

First Semester	Hours
CS 498 Software Engineering for Senior Project	3
CS Elective [C]	3
Technical Elective [T]	3
Free Elective [E]	4
UK Core (Global Dynamics)	3

Second Semester

CS 499 Senior Design Project*	3
CS Elective [C]	3
Technical Elective [T]	3
Non-Technical Elective [E]	3
Free Elective [E]	3

[N] – Any natural science course excluding more elementary versions of completed required courses.

[C] – Computer Science Elective (18 credit hours) – include 300-level and above computer science courses with at least three to be selected from: CS 335, CS 378, CS 405G, CS 441G, CS 450G, CS 460G and CS 463G. Students are encouraged to take advantage of special topics courses, cooperative education, independent studies and undergraduate research.

[T] – Technical Elective – include any 300-level and above courses in computer science, electrical engineering, mathematics and business and economics. MA 214 is also an acceptable technical elective. Cooperative education credit may be used to satisfy this requirement.

[E] – Elective – including one Free Elective and Non-Technical Elective. At least two of the electives (6 credits) cannot be in computer science, mathematics, science or engineering. Free Elective (3 credits) can be any course that carries Col credit and is not a more elementary version of a required course. Note: At least 128 credit hours; a foreign language requirement.

[S] – Science Elective – must be selected from either UK Core Natural Science or Social Science approved list or by consent of academic advisor.

Δ Both classes must be taken to fulfill UK Core: Arts & Creativity requirement.
*Graduation Composition and Communication Requirement (GCCR) course.

● Based on advisor consult

‡ Only if enrolled in PHY 231

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Computer Science

The Academic Minor

Many departments have designed academic minors for the convenience of undergraduate students.

A minor is a structured group of courses that leads to considerable knowledge and understanding of a subject, although with less depth than a major. Some employers consider minors desirable, and the corresponding major requirements at the University may stipulate a minor. Some students choose to complement their major program with a minor in a related field or even in an entirely different field of interest. Students interested in pursuing an academic minor should contact their Col dean's office and the department responsible for the minor program for guidance and advising.

Please note that undergraduate students can only complete a minor *in addition to* and as *a complement to* a major. The University does not award stand-alone minors.

Minor in Computer Science

The minor in computer science requires a minimum of 19-20 hours of course work in CS, to include the following:

EGR102 (2) or CS 115 (3), CS 215 (4), CS 216 (3), CS 275 (4), CS 315 (3), or equivalent, plus three additional hours of upper-division courses (300 or higher) in computer science. A GPA of at least 2.5 across these courses is required. At least 10 of the credit hours required to complete the minor must be earned at the University of Kentucky.

Electrical Engineering

Col of Engineering

The electrical engineering degree program seeks to produce graduates who are trained in the theory and practice of electrical and computer engineering and are well prepared to handle the professional and leadership challenges of their careers. The program allows students to specialize in high performance and embedded computing, microelectronics and nanotechnology, power and energy, signal processing and communications, high frequency circuits and fields, and control systems, among others.

Admission to the degree program is selective. Students should refer to the UK *Bulletin* for general information concerning admission and graduation requirements.

Degree Requirements

The following curriculum meets the requirements for a B.S. in Electrical Engineering, provided the student satisfies UK Core requirements and graduation requirements of the Col of Engineering.

Freshman Year

First Semester	Hours
EGR 101 Engineering Exploration I Δ §	1
EGR 102 Fundamentals of Engineering Computing	1
PHY 231 Gen Univ Phy PHYS 2404 or CHE 105 Gen Col Chem ICHEM 1351 ●	4
PHY 241 Gen Univ Phy Lab PHYS 2404 ‡	1
CIS/WRD 110 Composition and Communication I ENG 1301	3
MA 113 Calculus I MATH 1402	4
Second Semester	
EGR 103 Engineering Exploration II Δ	2
CIS/WRD 111 Composition and Communication II ENG 1302	3
MA 114 Calculus II MATH 2305	4
CHE 105 Gen Col Chem I CHEM 1351 or PHY 231 Gen Univ Phy PHYS 2404 ●	4
UK Core (Social Sciences) or CS 215 Introduction to Program Design, Abstraction, and Problem Solving	3/4

Sophomore Year

First Semester	Hours
MA 213 Calculus III MATH 2306	4
PHY 232 General University Physics PHYS 2405	4
PHY 242 General University Physics Laboratory PHYS 2405	1
EE 211 Circuits I	4
EE/CPE 282 Digital Logic Design	4
Second Semester	
MA 214 Calculus IV MATH 3301	3
EE 223 AC Circuits	4
EE/CPE 287 Intro to Embedded Systems	4
CS 215 Introduction to Program Design, Abstraction, and Problem Solving or UK Core (Social Sciences)	4/3
UK Core (Humanities)	3

Junior Year

First Semester	Hours
EE 415G Electromechanics	3
EE 421G Signals and Systems	3
Elective EE Laboratory [L]	2
EE 461G Introduction to Electronics	3
MA/STA 320 Introductory Probability MATH 3320 or STA 381 Engineering Statistics: A Conceptual Approach	3
Technical Elective [T]	3

Second Semester

EE 468G Introduction to Engineering Electromagnetics	4
Elective EE Laboratory [L]	2
Engineering/Science Elective [E]	3
Technical Elective [T]	3
UK Core (Citizenship – USA)	3

Senior Year

First Semester

	Hours
EE/CPE 490 ECE Capstone Design I † ‡, **	3
EE Technical Electives***	3
EE Technical Electives***	3
Math/Statistics Elective [M] MATH 3307	3
UK Core (Global Dynamics)	3

Second Semester

EE 491/CPE ECE Capstone Design II † ‡	3
EE Technical Electives***	3
EE Technical Electives***	3
Supportive Elective*	3
Engineering/Science Elective [E]	3
UK Core (Statistical Inferential Reasoning)	3

**Supportive elective is to be chosen from any University courses, excluding more elementary versions of required courses, such as precalculus mathematics or PHY 211.*

***Graduation Composition and Communication Requirement (GCCR) course.*

[M] *Math/Statistics Elective: Any upper-division (300-level or higher) math or statistics course excluding MA 308 and MA 310 (3 credit hours total).*

[E] *Engineering/Science Electives: Any engineering, physics, computer science, or math course at the 200-level or higher, other than an electrical engineering course and excluding MA 308, MA 310, and more elementary versions of required courses (6 credit hours total). Cooperative education credit may not be used to satisfy this requirement.*

[T] *Technical elective may be selected from upper-division (300-level or higher) engineering, mathematics, statistics, computer science, physics, or other technically-related fields excluding MA 308, MA 310, EE 305, and more elementary versions of required courses, to be selected in consultation with the academic advisor (3 credit hours total). Cooperative education credit may not be used to satisfy this requirement.*

[L] *Electrical Engineering Laboratory Elective: EE 462G, EE 422G, EE 416G (4 credit hours total).*

† ‡ *EE/CPE 490 is only taught in the fall semester. EE/CPE 491 is only taught in the spring semester.*

Δ *Both classes must be taken to fulfill UK Core: Arts & Creativity requirement.*

§ *Transfer students who declare a major will take EGR 112 Engineering Exploration for Transfer Students in place of EGR 101.*

● *Based on advisor consult*

‡ *Only if enrolled in PHY 231*

Students taking ENG 1301 and 1302 should also take one of the following: CART 1300, 1340 or 1341.

****EE Technical Electives (must be 500-level courses). Courses recommended as electrical engineering technical electives are listed below (each course is 3 credit hours):*

EE 511 Introduction to Communication Systems

EE 512 Digital Communication Systems

EE 513 Audio Signals and Systems

EE 517 Advanced Electromechanics

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Electrical Engineering • 2

EE 518 Electric Drives
EE 521 Introduction to Wireless Communications
EE 522 Antenna Design
EE 523 Microwave Circuit Design
EE 525 Numerical Methods and Electromagnetics
EE 527 Electromagnetic Compatibility
EE 531 Alternative and Renewable Energy Systems
EE532 Smartgrid: Automation and Control of Power Systems
EE 535 Power Systems: Generation, Operation and Control
EE 536 Power System Fault Analysis and Protection
EE 537 Electric Power Systems I
EE 538 Electric Power Systems II
EE 539 Power Distribution Systems
EE 546 Electric Power System Foundations
EE 560 Semiconductor Device Design
EE 561 Electric and Magnetic Properties of Materials
EE 562 Analog Electronic Circuits
EE 564 Digital Electronic Circuits
EE 565 Circuit Design With Analog Integrated Circuits
EE 567 Introduction to Lasers and Masers
EE 568 Fiber Optics
EE 569 Electronic Packaging Systems and Manufacturing Processes
EE 571 Feedback Control Design
EE 572 Digital Control of Dynamic Systems
EE 581 Advanced Logical Design
EE 582 Hardware Description Languages and Programmable Logic
EE 584 Introduction of VLSI Testing and Design
EE 585 Fault Tolerant Computing
EE 586 Communication and Switching Networks
EE 587 Microcomputer Systems Design
EE 589 Advanced VLSI
EE 599 Topics in Electrical Engineering (Subtitle required)

Materials Engineering

Col of Engineering

The materials engineer is responsible for the selection, preparation and application of existing materials and for the development of new and improved materials. Materials engineers study the relationships between atomic and/or molecular constitution, microstructure and physical properties including mechanical, thermal, electrical, and optical behavior. Classes of materials include metals, ceramics, polymers, and electronic materials.

Admission to the degree program is selective. Students should refer to the UK *Bulletin* for general information concerning admission and graduation requirements.

Degree Requirements

The following curriculum meets the requirements for a B.S. in Materials Engineering, provided the student satisfies the graduation requirements of the Col of Engineering.

Freshman Year

First Semester	Hours
EGR 101 Engineering Exploration I Δ §.....	1
EGR 102 Fundamentals of Engineering Computing	2
CHE 105 Gen Col Chem I CHEM 1351 or PHY 231 Gen Univ Phy PHYS 2404 •	4
CHE 111 General Col Chemistry Lab I CHEM 1251	1
CIS/WRD 110 Composition and Communication I ENG 1301	3
MA 113 Calculus I MATH 1402	4
Second Semester	
EGR 103 Engineering Exploration II Δ	2
CIS/WRD 111 Composition and Communication II ENG 1302	3
MA 114 Calculus II MATH 2305	4
PHY 231 Gen Univ Phy PHYS 2404 or CHE 105 Gen Col Chem I CHEM 1351 •	4
PHY 241 Gen Univ Phy Lab PHYS 2404	1
UK Core (Social Sciences).....	3

Sophomore Year

First Semester	Hours
MSE 201 Materials Science	3
CHE 107 General Col Chemistry II CHEM 1352	3
CHE 113 General Col Chemistry II CHEM 1252	2
MA 213 Calculus III MATH 2306	4
EM 221 Statics	3
MSE 202 Materials Science Laboratory.....	1
Second Semester	
MSE 301 Materials Science II.....	3
MSE 351 Materials Thermodynamics	3
MA 214 Calculus IV MATH 3301	3
PHY 232 General University Physics PHYS 2405	4
CHE 236 Survey of Organic Chemistry	3

Students taking **ENG 1301** and **1302** should also take one of the following: **CART 1300, 1340 or 1341.**

Junior Year

First Semester	Hours
MSE 401G Metal and Alloys	3
MSE 404G Polymeric Materials	3
CME 200 Process Principles	3
EM 302 Mechanics of Deformable Solids.....	3
STA 381 Engineering Statistics: A Conceptual Approach.....	3
UK Core (Humanities).....	3
Second Semester	
MSE 402G Electronic Materials and Processing	3
MSE 403G Ceramic Engineering and Processing.....	3
MSE 407 Materials Laboratory I ***	3
MSE 535 Mechanical Properties of Materials.....	3
PHY 361 Principles of Modern Physics PHYS 3408	3

Senior Year

First Semester	Hours
MSE 408 Materials Laboratory II.....	3
MSE 436 Material Failure Analysis.....	3
MSE 585 Materials Characterization Techniques.....	3
EE 305 Electrical Circuits and Electronics	3
Technical Elective** (MSE prefix).....	3
UK Core (Citizenship – USA)	3
Second Semester	
MSE 480 Materials Design	3
MSE 538 Metals Processing	3
Technical Elective ** MATH 3307	3
Supportive Elective*	3
UK Core (Global Dynamics).....	3

*Supportive elective is any university course, excluding more elementary versions of required courses, such as precalculus mathematics or PHY 211.

Δ Both classes must be taken to fulfill UK Core: Arts & Creativity requirement.

§ Transfer students who declare a major will take EGR 112 Engineering Exploration for Transfer Students in place of EGR 101.

• Based on advisor consult

*** Graduation Composition and Communication Requirement (GCCR) course.

**Technical Electives – Total of 6 credit hours must be chosen. Technical electives are to be selected from a technical discipline, with approval from the Director of Undergraduate Studies. At least 3 credit hours must come from a course with a MSE prefix. MSE 395 (Research) may count for one elective, but not both. Recommended technical electives include but are not limited to:

- MSE 395 Independent Work in Materials Engineering
- MSE 506 Mechanics of Composite Materials
- MSE 531 Powder Metallurgy
- MSE/CME 554 Chemical and Physical Processing of Polymer Systems
- MSE 556 Introduction to Composite Materials
- MSE 569 Electronic Packaging Systems and Manufacturing Processes
- MSE 599 Topics in Materials Science and Engineering (Subtitle required)
- CHE 580 Topics in Chemistry
- CME 542 Electric Power Generation Technologies
- MA 322 Matrix Algebra and Its Applications
- MA 422 Numerical Solutions of Equations
- MA 432G Methods of Applied Mathematics I
- ME/MFS 503 Lean Manufacturing Principles and Practices

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Mechanical Engineering

Col of Engineering

A mechanical engineering training is the broadest among the several fields of engineering. The mechanical engineer uses the techniques of mathematics combined with a specialized knowledge of the thermal and energy sciences, solid and fluid mechanics, and the properties of materials. This information is supplemented by an understanding of manufacturing processes, the design and control of systems, and the economics of the technological community.

Admission to the program is selective. Students should refer to the UK *Bulletin* for general information concerning admission and graduation requirements.

Degree Requirements

The following curriculum meets the requirements for a Bachelor of Science in Mechanical Engineering, provided the student satisfies the graduation requirements of the Col of Engineering.

Freshman Year

First Semester	Hours
EGR 101 Engineering Exploration I Δ §.....	1
EGR 102 Fundamentals of Engineering Computing	2
PHY 231 Gen Univ Phy PHYS 2404 or CHE 105 Gen Col Chem I CHEM 1351 ●4	4
PHY 241 Gen Univ Phy Lab‡ PHYS 2404	1
CIS/WRD 110 Composition and Communication I ENG 1301	3
MA 113 Calculus I MATH 1402	4
Second Semester	
EGR 103 Engineering Exploration II Δ	2
CIS/WRD 111 Composition and Communication II ENG 1302	3
MA 114 Calculus II MATH 2305	4
CHE 105 Gen Col Chem II CHEM 1351 or PHY 231 Gen Univ Phy PHYS 2404 ●4	4
UK Core (Social Sciences)	3

Sophomore Year

First Semester	Hours
PHY 232 General University Physics PHYS 2405	4
PHY 242 General University Physics Laboratory PHYS 2405	1
MA 213 Calculus III MATH 2306	4
CHE 107 General Col Chemistry II CHEM 1352 or UK Core (Humanities)	3
ME 205 Computer Aided Engineering Graphics	3
EM 221 Statics	3
Second Semester	
ME 220 Engineering Thermodynamics I.....	3
ME 251 Manufacturing Engineering	3
MA 214 Calculus IV MATH 3301	3
EM 313 Dynamics.....	3
UK Core (Humanities) or CHE 107 General Col Chemistry II CHEM 1352	3
UK Core (Statistical Inferential Reasoning).....	3

Students taking ENG 1301 and 1302 should also take one of the following:
CART 1300, 1340 or 1341.

Junior Year

First Semester	Hours
EM 302 Mechanics of Deformable Solids	3
EE 305 Electrical Circuits and Electronics	3
ME 330 Fluid Mechanics	3
ME 340 Introduction to Mechanical Systems.....	3
WRD 204 Technical Writing*	3
Second Semester	
ME 310 Engineering Experimentation I.....	3
ME 321 Engineering Thermodynamics II	3
ME 325 Elements of Heat Transfer.....	3
ME 344 Mechanical Design.....	3
Math Elective*** MATH 3307	3

Senior Year

First Semester	Hours
ME 411 ME Capstone Design I*.....	3
ME 311 Engineering Experimentation II	3
ME 440 Design of Control Systems	3
ME 501 Mechanical Design with Finite Element Methods.....	3
Technical Elective†	3
Second Semester	
ME 412 ME Capstone Design II.....	3
Technical Electives†.....	3
Technical Electives†.....	3
Supportive Elective **.....	3
UK Core (Global Dynamics)	3
UK Core (Citizenship USA)	3

Δ Both classes must be taken to fulfill UK Core: Arts & Creativity requirement.

● Based on advisor consult

‡ Only if enrolled in PHY 231

§ Transfer students who declare a major will take EGR 112 Engineering Exploration for Transfer Students in place of EGR 101.

*Graduation Composition and Communication Requirement (GCCR) course.

**Supportive elective is any university course, excluding more elementary versions of required courses, such as precalculus mathematics or PHY 211.

† Technical Electives—Choose 9 hours from the following:

- ME 380 Topics in Mechanical Engineering (Variable Topics)
- ME 395 Independent Work in Mechanical Engineering
- ME/MFS 503 Lean Manufacturing Principles and Practices
- ME/MFS 505 Modeling of Manufacturing Processes and Machines
- ME/MSE 506 Mechanics of Composite Materials
- ME/MFS 507 Design for Manufacturing
- ME 510 Vibro-Acoustic Design in Mechanical Systems
- ME/MFS 512 Manufacturing Systems
- ME 513 Mechanical Vibrations
- ME 514 Computational Techniques in Mechanical System Analysis
- ME 515 Rotordynamics of Turbomachinery
- ME 516 Systems Engineering
- ME 527 Applied Mathematics in the Natural Sciences I
- ME 530 Gas Dynamics

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Mechanical Engineering

Col of Engineering

ME 531 Fluid Dynamics I
ME 532 Advanced Strength of Materials
ME 548 Aerodynamics of Turbomachinery
ME 549 Power Generation
ME/MSE 556 Introduction to Composite Materials
ME 560 Engineering Optics
ME 563 Basic Combustion Phenomena
ME 565 Scale Modeling in Engineering
ME/BAE 580 Heating, Ventilating and Air-Conditioning
ME 599 Topics in Mechanical Engineering (Subtitle required)
MFS 599 Topics in Manufacturing Systems Engineering (Subtitle required)
EGR 599 Topics in Engineering
MSE 201 Materials Science
BAE 502 Modeling of Biological Systems
BME 501 Foundations of Biomedical Engineering
BME 530 Biomedical Instrumentation

*** Mathematics Elective

MA 320 Introductory Probability
MA 321 Introduction to Numerical Methods
MA 322 Matrix Algebra and Its Applications
MA 416G Introduction to Optimization
MA 432G Methods of Applied Mathematics I
MA 433G Introduction to Complex Variables
MA 481G Differential Equations
STA 381 Engineering Statistics- A Conceptual Approach

Mining Engineering

Col of Engineering

Mining engineering requires a broad knowledge of sciences and other fields of engineering in its practice after graduation. The curriculum below meets the requirements for a Bachelor of Science in Mining Engineering, provided the student satisfies the graduation requirements of the Col of Engineering.

Admission to the program is selective. Students should refer to the UK *Bulletin* for general information concerning admission and graduation requirements.

Degree Requirements

Freshman Year

First Semester	Hours
EGR 101 Engineering Exploration I Δ §	1
EGR 102 Fundamentals of Engineering Computing	2
CHE 105 Gen Col Chem I CHEM 1351 or PHY 231 Gen Univ Phy PHYS 2404 ●	4
PHY 241 Gen Univ Phy Lab PHYS 2404 or CHE 111 Gen Col Chem Lab II CHEM 1251 ∞	1
CIS/WRD 110 Composition and Communication I ENG 1301	3
MA 113 Calculus I MATH 1402	4

Second Semester

EGR 103 Engineering Exploration II Δ	2
CIS/WRD 111 Composition and Communication II ENG 1302	3
MA 114 Calculus II MATH 2305	4
PHY 231 Gen Univ Phy PHYS 2404 or CHE 105 GenColChem I CHEM 1351 ●	4
UK Core (Social Sciences)	3

Sophomore Year

First Semester	Hours
EM 221 Statics	3
EES 220 Principles of Physical Geology	4
MA 213 Calculus III MATH 2306	4
MNG 201 Mining Engineering Fundamentals	3
PHY 232 General University Physics PHYS 2405	4

Second Semester

EES 230 Fundamentals of Geology I	3
EM 302 Mechanics of Deformable Solids	3
MA 214 Calculus IV MATH 3301	3
ME 220 Engineering Thermodynamics I	3
MNG 291 Elements of Mine Design	3
MNG 303 Deformable Solids Laboratory	1
MNG 331 Explosives and Blasting	2

Junior Year

First Semester	Hours
ME 330 Fluid Mechanics	3
MNG 211 Mine Surveying	2
MNG 301 Minerals Processing	3
MNG 302 Minerals Processing Laboratory	1
MNG 335 Introduction to Mine Systems Analysis †	3
MNG 351 Underground Mine Design	3
UK Core (Humanities)	3

Students taking ENG 1301 and 1302 should also take one of the following:
CART 1300, 1340 or 1341.

Second Semester

MNG 311 Electrical Circuits and Mining Machinery	3
MNG 322 Mine Safety & Health Management and Processes	2
MNG 371 Professional Development of Mining Engineers***	3
MNG 435 Mine Systems Engineering and Economics	4
MNG 463 Surface Mine Design	3
Minerals Processing Technical Elective*	3

Senior Year

First Semester	Hours
EM 313 Dynamics	3
MNG 332 Mine Plant Machinery	3
MNG 341 Mine Ventilation	3
MNG 551 Rock Mechanics	4
MNG 564 Environmental Control System Design and Reclamation	3
MNG 591 Mine Design Project I	1

Second Semester

MNG 592 Mine Design Project II	3
Technical Elective**	3
Supportive Elective ††	3
UK Core (Citizenship-USA)	3
UK Core (Global Dynamics)	3

*The Mineral Processing Technical Elective is to be chosen between MNG 575, Coal Preparation Design, and MNG 580, Mineral Processing Plant Design.

**Courses recommended as technical electives are listed below. These courses must be chosen with the approval of the student's advisor to ensure that the curriculum includes sufficient engineering design content.

***Graduation Composition and Communication Requirement (GCCR) course.

†MNG 335 satisfies the Statistical Inferential Reasoning requirement in the UK Core.

∞ Confirm proper prerequisites.

● Based on advisor consult

Δ Both classes must be taken to fulfill UK Core: Arts & Creativity requirement.

§ Transfer students who declare a major will take EGR 112 Engineering Exploration for Transfer Students in place of EGR 101.

†† Supportive elective is any university course, excluding more elementary versions of required courses, such as precalculus mathematics or PHY 211.

Technical Electives: Students are required to select their technical elective from the departmental courses listed below:

- MNG 511 Mine Power System Design
- MNG 531 Advanced Blast Design and Technology
- MNG 541 Computer Design of Mine Ventilation Systems
- MNG 561 Mine Construction Engineering I
- MNG 575 Coal Preparation Design
- MNG 580 Mineral Processing Plant Design
- MNG 599 Topic in Mining Engineering

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