

Rose-Hulman Institute of Technology Course Catalog

Fast Track Calculus	Minor in Entrepreneurial Studies
Accelerated Math Physics	Multidisciplinary Minor in Imaging
New Student Orientation	Certificate In Semiconductor Materials And Devices
Consulting Engineering Program	The Management Studies Program
Study Abroad	German Technical Translator's Certificate Program
Integrated Circuit Testing Certificate	Multidisciplinary Minor in Robotics
Multidisciplinary Minor in Data Science	Minor in Sustainability
Minor in Materials Science and Engineering	Multidisciplinary Minor in Cognitive Science
Multidisciplinary Minor in Systems Engineering	

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FAST TRACK CALCULUS

Integral and multivariable calculus, is offered during the summer (late July through late August) for selected members of our entering freshman class who have demonstrated outstanding ability in mathematics and studied a year of calculus during high school. Participants are expected to have scored at least 700 on the mathematics portion of the SAT or 31 on the mathematics portion of the ACT. Students, who have a 700 Math Score or 680 math/700 critical reading or better on the SAT, or a 30 mathematics score and at least a 31 English score on the ACT have also been admitted to the program. Participants who successfully complete Fast Track Calculus satisfy Rose-Hulman's freshman Calculus requirement, are awarded 15 quarter hours of credit toward graduation, and begin their college careers as "mathematical sophomores."

Admission to Fast Track Calculus is competitive. Interested students should contact the Head of the Mathematics Department or Director of Fast Track Calculus.

ACCELERATED MATH PHYSICS

An integrated calculus and physics course is offered during the summer (late July through late August) for selected members of our entering freshman class who have demonstrated outstanding ability in mathematics and physics having taken a year of college level calculus during high school and one year of high school physics. Participants are expected to have scored at least 700 on the mathematics portion of the SAT or 31 on the mathematics portion of the ACT. Students, who have a 700 mathematics score or 680 mathematics/700 critical reading or better on the SAT, or a 30 mathematics score and at least a 31 English score on the ACT have also been admitted to the program. Participants who successfully complete the Accelerated Math Physics Program will earn credit for MA113, PH111, and PH112. Selected students are expected to have the ability to place out of MA111 and MA112, so will start in the Fall quarter having credit for MA111, MA112, MA113, PH111, PH112 – effectively as sophomores. Admission to the Accelerated Math Physics Program is competitive. Interested students should contact the Directors of the Accelerated Math Physics Program.

NEW STUDENT ORIENTATION

To aid entering students in their adjustment to college life, a five-day orientation period for students precedes regular classroom instruction prior to the start of the academic year. Each freshman is required to be present for this program. The program offers a number of advantages to both the students and faculty. The students become acquainted with the facilities and surroundings, with each other, and the facilities, a UPn period

	Credit
EM102/EM104 Graphical Communications	2
RH330 Technical Communications	4
Or	
IA230 Fundamentals of Public Speaking	4
SV351 Managerial Economics	4
Or	
EMGT 432/532 Technical Entrepreneurship	4
CE303 Engineering Economy	4
Or	
CHE416 Design I: Process Economics and Equipment Design	4
EMGT552 Business Law for Technical Managers	4
CE420/CHE420/ECE466 or ME420 Consulting Engineering Seminar	2
Engineering Design (any senior Engineering design course)	4
Total	24
Exceptions to these program course requirements require approval by the Consulting Engineering Program Advisor.	
Registration for & sitting for the Fundamentals of Engineering Exam required.	

MULTIDISCIPLINARY MINOR IN DATA SCIENCE

Any student may obtain a Multidisciplinary Minor in Data Science by taking the following courses:

Introductory Statistics Course (4 credit hours):

One of the following courses

- MA223 Engineering Statistics I
- MA382 Introduction to Statistics with Probability

Introductory Computer Science Courses (8 credit hours):

- CSSE120 Introduction to Software Development
- CSSE220 Object Oriented Software Development

Electives (16 credit hours):

Two courses from the list below:

- MA386 Statistical Programming

- MA384 Data Mining
- CSSE 230 Data Structures & Algorithm Analysis

A minimum of two additional course from the list below: (See degree separation requirement below.)

- BMTH312 Bioinformatics
- CSSE333 Database Systems
- CSSE413 Artificial Intelligence
- CSSE433 Advanced Database Systems
- CSSE434 Introduction to the Hadoop Ecosystem
- CSSE463 Image Recognition
- CSSE481 Web-Based Info Systems
- CSSE490 Internet of Things
- CSSE335/MA335 Introduction to Parallel Computing
- MA384 Data Mining
- MA386 Statistical Programming
- MA482 Bioengineering Statistics
- MA483 Bayesian Data Analysis
- MA485 Applied Regression and Time Series
- MA490 Machine Learning
- MA490 Deep Learning
- ME447 Visualizing Data
- ME497 Reproducible Research
- PH327 Thermodynamics and Statistical Mechanics
- SV450 Econometrics

Notes and limitations on requirements:

- Degree Separation Requirement: The Multidisciplinary Minor in Data Science must be separated from any other minor and the named required courses of any major by a minimum of 16 credit hours. Exceptions to this requirement must be approved by the minor advisor for Data Science and the heads of both the Department of Mathematics and the Department of Computer Science and Software Engineering.
- Electives not listed above may be substituted with other courses with the approval of the minor advisor for Data Science.
- The minor plan of study must be approved by the minor advisor for Data Science and the student's advisor.

STUDY ABROAD

Students are provided the opportunity to enhance their academic experience by studying at an institution abroad. The Office of Global Programs offers information and support for students interested in immersive study abroad. To ensure the integrity of the experience, the following policies have been established.

- Students with a cumulative grade point average of 2.75 or higher, and who will have completed at least 45 earned credit hours at Rose-Hulman by the time of study abroad may apply for approval to enroll in a study abroad program.
- Students must be in good academic standing to apply for study abroad, including dual degree programs. Students who fall out of good academic standing between

approval and the beginning of study abroad will be ineligible to study abroad until they are back in good standing.

- Students must remain in good standing during their study abroad program.
- Approved study abroad students will remain enrolled at the institute during the quarter or academic-year study abroad period.
- Students studying in a single location where English is not an official language are expected to study the official language of that country while studying abroad if they do not already have proficiency in that language.
- Students must maintain full-time status at the host institution and must receive a grade of “C” or better (converted to US system) in order for courses to be transferred in. Courses taken abroad for pass/fail credit will not be considered for transfer in.
- All study abroad credit, including dual degree, will be treated as transfer credit and will not be factored into cumulative GPA.
- Students may not have already graduated at the time of study abroad.
- Academic Misconduct will be taken into consideration as part of the approval process.
- Students will be subject to Rose-Hulman’s Code of Ethics while participating in study abroad.

Exceptions to the above policies may be considered for transfer students and on a case-by-case basis by the Office of Global Programs.

Three of ten elective courses are required.

ECE551: Digital VLSI

ECE552: Analog Integrated Circuit Design

ECE553: RF Integrated Circuit Design

ECE343: High-Speed Digital Design (required for CPE program)

ECE416: Intro to MEMS

Required courses: **CSSE351, CSSE451, MA323**

Plus three electives from the **Imaging Electives** list below.

Recommended electives: **MA371 or MA373, ECE480, CSSE/MA325, IA142 or IA244**

Track 4: Acquisition of Images

Expected majors: **ECE, PHOE, BE**

Required courses: **ECE480/OE437, PH405, OE295**

Plus three electives from the **Imaging Electives** list below.

Recommended electives: **OE480, OE392**

Track 5: Creative Imaging

Expected majors: **CS/SE, ECE, MA**

Required courses: **IA142, ECE480, CSSE/MA325**

Plus three electives from the **Imaging Electives** list below.

Recommended electives: **CSSE351, MA323, IA244**

Imaging Electives (choose any 12 credits that are not required for your track, as long as at least 12 of the 24 credits for the minor are not named, required courses for your major)

BE340 Biomedical Signal Processing or ECE380 Discrete-Time Signal Processing (only one can be taken as a minor elective)

BE435/OE435 Biomedical Optics

CSSE325/MA325 Fractals and Chaotic Dynamical Systems

CSSE351 Computer Graphics,

CSSE413 Artificial Intelligence

CSSE451 Advanced Computer Graphic

CSSE461 Computer Vision

CSSE463 Image Recognition

ECE480/OE437 Introduction to Image Processing

ECE580 Digital Signal Processing

ECE582/PH537 Advanced Image Processing

ECE584/BE541 Medical Imaging Systems

IA142 Drawing or IA244 Design and Color (only one can be taken as a minor elective)

MA323 Geometric Modeling

MA371 Linear Algebra or MA373 Applied Linear Algebra

MA439 Mathematical Methods of Image Processing

MA490 Deep Learning

MA490 Machine Learning

OE295 Photonics Devices and Systems OE392 Linear Optical Systems.

OE480 Optical System Design

OE592 Fourier Optics and Applications

PH405 Semiconductor Materials and Applications

PH538 Introduction to Neural Networks

Any special topics course or independent study in any major that involves imaging (must be approved by the Imaging Program Director).

MINOR IN MATERIALS SCIENCE AND ENGINEERING

Materials science and engineering is a broad field of study. As the name implies, it encompasses foundational knowledge from the sciences (e.g. physics, chemistry, and biology) and it includes the engineering application of this knowledge to create new

ME 428	Materials Research and Instrumentation	4	CHEM 111 and Jr Standing
ME 517	Mechanics of Metal Forming	4	EM 204
OE 360	Optical Materials	4	PH 255 and PH 316
PH 255	Foundations of Modern Physics	4	PH 113 and MA 211*
PH 405	Semiconductor Materials & Applications	4	PH 113 or PH 255 or PH 265
PH 407	Solid State Physics	4	PH 255 or PH 265
PH 440	X-rays and Crystalline Materials	4	PH 255 or PH 265
CHEM 470	Absorption Spectroscopy	1	**
CHEM 470	Raman Spectroscopy	1	**
CHEM 470	Microfluidics	1	**
PH 113 OR EM 204	Physics III ³ Or Statics & Mechanics of Materials II ³	4	PH 112 and MA 112 and MA 113* Or EM 121
With permission of a minor advisor, up to four credit hours of independent study and/or self-directed research		≤ 4	

¹CE majors may count CE 320 toward fulfillment of the minor even though it is in category (2)

²CHE 315 and ME 328 cannot both count toward fulfillment of the minor

³PH 113 or EM 204 cannot be taken as a terminal course. A materials elective that requires

PH 113 or EM 204 as a prerequisite must also be taken in fulfillment of minor requirements.

*corequisite course; **consent of instructor; *** or concurrent registration

- **A maximum of 8 credit hours of the following elective courses that focus on mechanics of materials:**

Description

ECE 551	4	Digital Integrated Circuit Design
ECE 552	4	Analog Integrated Circuit Design
ME 302	4	Heat Transfer
ME 328	4	Materials Engineering
ME 424	4	Composite Materials & Mechanics
ME 415	4	Corrosion and Engineering Materials
CHE 314	4	Heat Transfer
CHE 315	4	Material Science and Engineering
CHE 440	4	Process Control
CHE 441	4	Polymer Engineering
CHEM 441	4	Inorganic Chemistry I
CHEM 451	4	Organic Structure Determination
CHEM 457	4	Synthetic Polymer Chemistry
CHEM 462	4	Physical Polymer Chemistry
MA 381	4	Intro to Probability with Applications to Statistics
MA 385	4	Quality Methods
MA 487	4	Design of Experiments

Overall aim of the Certificate

A certificate holder will understand how semiconductor devices work, have practical experience in the main stages of device production, have practical experience in the more common forms of device testing and characterization, and have broad understanding of the mechanical and chemical properties of the material used.

A Certificate holder will be well suited for jobs requiring an understanding of semiconductor devices and their production. These jobs include not only those directly related to device fabrication, but also those involved with testing and trouble-shooting electronic equipment and the design of machines that contain electronic equipment. The experience in simple device fabrication that the Certificate provides is particularly useful for future engineers in “process” industries.

with electives dealing with the role of management in society and specific tools for managers.

Statement of Objectives

The Management Studies Program broadens the education of engineers and scientists through a curriculum which:

- teaches the quantitative and economic concepts needed in management decision-making;
- promotes productivity through people;
- stresses communication skills required in management;
- examines intended and unintended impacts of management decisions;
- explores the social, legal, and ethical contexts of management.

Although the nine courses necessary to receive the certificate are a challenging addition to the undergraduate's academic load, many of them may simultaneously be used to fulfill Humanities and Social Science, technical elective, and other degree requirements. Science majors should be able to complete the program easily within the regular four year pattern, but engineering majors may have to overload. In order to minimize conflicts and meet individual needs, each student will design a specific program with the Management Studies Adviser in the first quarter of the sophomore year.

Requirements:

1. All of the following core Courses:
SV151 Principles of Economics
SV303 Business and Engineering Ethics
RH330 Technical and Professional Communication
SV350 Managerial Accounting or SV356 Corporate Finance
SV351 Managerial Economics
2. Two of the following Management in Society Courses (in addition to the core courses):
SV171 Principles of Psychology
EMGTXXX Engineering Management
SV304 Bioethics
EMGT533 Intercultural Communication
GS432 Literature and Film of the Global Economy
SV353 Industrial Organization
SV357 Labor Economics
IA352 Game Theory
SV463 Seminar on America's Future
IA453 The Entrepreneur
EMGT526 Technology Management and Forecasting
3. Two courses from the following list. The student may choose to emphasize a strength area such as quantitative analysis, economics, or engineering management. Courses not included in this list may be approved by the Management Studies Advisor:
CE303 Engineering Economy
SV353 Industrial Organization

IA350 Intermediate Microeconomics
IA351 Intermediate Macroeconomics
GS350 International Trade: Globalization
GS351 International Finance
CE441 Construction Engineering
CE442 Cost Engineering
MA444 Deterministic Models in Operations Research
MA445 Stochastic Models in Operations Research
CSSEXXX Courses beyond CSSE 120 in Computer Science
MAXXX Any statistics courses
EMGTXXX Any engineering management course

GERMAN TECHNICAL TRANSLATOR'S CERTIFICATE PROGRAM

A student may earn, in addition to one of the regular degree programs in science or engineering, a certificate of proficiency in German technical translation. Successful completion of this non-degree program partially fulfills the graduation requirements in humanities and social sciences.

Certificate Requirements

A student must have a 3.0 in the first two years of the foreign language and in his/her

In addition to the courses listed above students completing the robotics minor need to complete the courses below that apply to their major. (Students with a double major or double degree may choose which major to use. If a student decides to switch majors, that student must complete a track below appropriate for their final degree. These degree requirements are evaluated only at the time of your graduation.)

(1) CS and SE majors -

Students choose Robotics Electives from the list below subject to the restrictions that a student's Robotics Elective courses(s) cannot be any course listed above as an additional required course for the student's major, and cannot be a course listed as a named requirement for the student's major.

- BE350 Biocontrol Systems
- BE520 Brain Machine Interfaces
- BE543 Neuroprosthetics
- CSSE413 Artificial Intelligence
- CSSE480 Web App Frameworks with AppEngine
- CSSE483 Android Application Development
- CSSE484 iOS Application Development
- CSSE461 Computer Vision
- CSSE463 Image Recognition
- CSSE490 Swarm Intelligence
- CSSE290/490 Teamwork and Robotics
- CSSE290/490 Software Challenges in Robotics
- ECE320 Linear Controls
- ECE300 Continuous Time Signals and Systems
- ECE414 Wireless Systems
- ECE420 Discrete-time Control Systems
- ECE480/PH437 Image Processing
- ECE483 Digital Signal Processing System Design
- ECE582/PH537 Advanced Image Processing
- ECE583 Pattern Recognition
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- EMGT472 – Reliability Engineering
- EMGT445 – Quality Metineering