Rose-Hulman Institute of Technology Course Catalog

| Communications Systems Certificate | Optical Communications Certificate | |
|--|-------------------------------------|--|
| Consulting Engineering Program | Power Certificate | |
| Certificate | Semiconductor Materials and Devices | |
| Integrated Circuit Testing Certificate | Certificate | |
| International Studies Certificate | | |

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Communications Systems Certificate

Certificate Advisor: Dr. Yong Jin Kim Take all of these required courses: ECE 300 Continuous-Time Signals Systems ECE 380 Discrete-Time Signals and Systems MA 381 Introduction to Probability with Applications to Statistics Plus any four courses from the following list. Additional courses not in this list may be approved by the Certificate Advisor. ECE 310 Communication Systems ECE 312 Communication Networks ECE 412 Software Defined Radio ECE 414 Wireless Systems ECE 512 Probability, Random Processes, and Estimation ECE 553 Radio-Frequency Integrated Circuit Design CSSE 432 Computer Networks

MA 476 Algebraic Codes

CONSULTING ENGINEERING PROGRAM CERTIFICATE

Through the generosity of J. B. Wilson, a prominent consulting engineer of Indianapolis, a program was established in 1973 to emphasize career opportunities in the field of consulting engineering and to provide selected courses which would be beneficial to students interested in consulting engineering careers.

Listed below is a program guide of recommended courses for a student interested in consulting engineering. This is not a degree program but is a supplement to the normal engineering degree programs. Some of the courses are in addition to the normal engineering degree programs and may result in a student earning more credits than are required for the B.S. degree in a specific discipline.

Students desirous of pursuing the Consulting Engineering Program should enroll in the Program by filing a declaration-of-intent form with the Program advisor, who serves as Chair of the Program. In order to be certified as having completed the Program, a student is required to successfully complete the prescribed list of courses, complete the

requirements for a degree in Engineering, and take the Fundamentals of Engineering examination prior to graduation.

Upon completion of the program, students will receive a Certificate of Completion at the time of their graduation from Rose-Hulman Institute of Technology. Completion of the program will be noted on the student's official transcript but not on the diploma. The Consulting Engineer Program advisor is Dr. Kevin Sutterer P.E., Ph.D., Department of Civil and Environmental Engineering.

Download the Consulting Engineering Intention Form

| Course | Credit |
|---|--------|
| EM 102 Graphical Communications for Civil Engineers Or | 2 |
| EM 104 Graphical Communications | |
| BE 118 Design Thinking & Communication Or | |
| ENGD 100 Design & Communication Studio | |
| ENGL H290 Technical Communications | 4 |
| Or ENGD 250 Human-Computer Interfaces Studio | |
| ECON S253 Managerial Economics Or | 4 |
| EMGT 432/532 Technical Entrepreneurship | |
| CE303 Engineering Economy Or | 4 |
| CHE416 Chemical Engineering Design | |
| Or EMGT 467 Economic Analysis of Engineering Projects | |
| EMGT552 Business Law for Technical Managers Or | 4 |
| EMGT 551 Intellectual Property for Scientists and Engineers | |
| MDS 450 Consulting Engineering Seminar | 2 |
| Engineering Design (any senior capstone design course or courses) | 4 |
| | |

Exceptions to these program course requirements require approval by the Consulting Engineering Program Advisor.

Registration for & sitting for the Fundamentals of Engineering Exam is required.

INTEGRATED CIRCUIT TESTING CERTIFICATE

Testing integrated circuits is a critical element in the integrated circuit industry. In fact, testing has become the bottle-neck for many companies, with inefficient test programs preventing the release of products onto the market. With few colleges offering courses in this area, students at RHIT have a unique specialization opportunity, making them marketable and extremely valuable in the integrated circuit industry.

This certificate intends to provide the student with a solid background in test and product engineering and broaden that background with other courses pertinent to the test and product engineering field. A strong test/product engineer requires knowledge about integrated circuit design, systems design, board design, semiconductor fabrication, and statistics. Therefore, courses in these areas can be chosen for the elective portion of the certificate.

The test and product engineering certificate could be completed by an electrical or computer engineering student without overloading if the certificate courses are mapped to all but one of the Area, Technical, and Free electives. Electives have been chosen so that students can pursue the semiconductor certificate or a math minor in conjunction.

Certificate Requirements

ECE351: Analog Electronics is required.

Two of the three testing courses are required.

ECE557: Analog Test and Product Engineering ECE558: Mixed-Signal Test and Product Engineering ECE531: Digital Test and Product Engineering

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 ECE419: Advanced MEMS ECE454: System Level Analog Electronics ECE557: Analog Test and Product Engineering (if not used for required testing course) ECE558: Mixed-Signal Test and Product Engineering (if not used for required testing course) ECE531: Digital Test and Product Engineering (if not used for required testing course) PH405: Semiconductor Materials and Device I EP406: Semiconductor Materials and Devices II MA385: Quality Methods Engineering MA387: Statistical Methods in Six Sigma For further information about the certificate program, please contact Tina Hudson (hudson@rose-hulman.edu).

INTERNATIONAL STUDIES CERTIFICATE

Certificate Advisor: Dr. Andreas Michel

In addition to the International Studies major, Rose-Hulman offers a certificate in International Studies. Like the major, the certificate is designed to introduce students to the diversity and complexity of the globalized world in which they will be working. Students may choose courses from a variety of disciplines, historical periods, and geographical areas from the list below.

Certificate Requirements (36 credits)

- 1. HUM H199 or SOC S199 Introduction to International Studies (4 credits)
- 2. First-year modern language proficiency (three courses, 12 credits)
- 3. Five courses with international studies content (20 credits) from this list:

ANTH S101 Introduction to Anthropology ANTH S140 Introduction to East Asia ANTH S151 Modern China ANTH S150 Introduction to Islam ANTH S207 Popular Culture in China ANTH S208 Religions in China ANTH S301 Japanese Society ANTH S302 Japanese Society Seminar ANTH S303 Japanese Popular Culture ANTH S304 Japan: East and West ANTH S350 Islam and Muslim Groups in China ANTH S351 Ethnicity and State in China ANTH S399 Cultures of Tibet **ARTS H242 Visual Arts in Civilization** ARTS H442 Art History **ECON S151 Introduction to Microeconomics** ECON S152 Introduction to Macroeconomics **ECON S351 Environmental Economics ECON S355 International Finance** ECON S354 International Trade and Globalization **ECON S399 Development Economics ENGL H233 World Literature** ENGL H330 Contemporary Global Film ENGL H334 Travel in World Literature ENGL H345 Literature of Conflict ENGL H431 Literary London ENGL H462 Transnational and Colonial Literature ENGL H469 Contemporary British Fiction and Film HIST H221 Colonial Latin America HIST H222 Latin America Since 1800 HIST H223 World History since 1400

HIST H422 The Industrial Revolution in Global Context HUM H311 German Colonialism HUM H380 Literature and Human Rights in Latin America MUSI H301 Musics of the Global South POLS S102 International Relations POLS S103 Comparative Politics POLS S200 Politics of the Global Economy POLS S301 European Politics and Government POLS S303 The European Union POLS S304 British Politics and Government

- 1. Course substitutions can be made with the consent of the International Studies Coordinator.
- Courses counted for the International Studies certificate may not be counted for HSSA minors —except that modern foreign language courses may be used to fulfill modern language requirements in one additional minor.
- 3. Students who complete the requirements for the International Studies Major cannot also be awarded the International Studies Certificate.

Optical Communications Certificate

Faculty advisors: Drs. Alisafaee, Duree, Joenathan, Reza, Siahmakoun, and Granieri

Rose-Hulman has become a leader in providing opportunities for students to choose a great mainstream degree program with flexibility to specialize in other areas of interest. This leadership is in no way limited to only traditional areas of study. One of these new areas that had a high impact in technology is optical communications. It is a rapidly growing field requiring investment beyond the traditional program structure, and is well suited to the students at Rose-Hulman All these topics are closely related to well established disciplines as optics and electronics. Considerable R&D efforts are allocated in both university and industrial laboratories enhancing the demand for both researchers and engineers with expertise in the field.

We propose the creation of a new certificate program in Optical Communications to enhance the programs currently offered. Combining expertise in Optical and Electrical Engineering, this program requires an interdisciplinary emphasis that is beyond the traditional content of either of its parent programs. This program is more than just the creation of the certificate program Optical Communications. This program will be critical to help developing a more interdisciplinary interaction for students and faculty. The creation of a workgroup within the faculty of both departments will coordinate current courses and resources, create new courses of interest for the field, and develop a showcase testbed education and research laboratory. Primary objectives include the removal of redundancy from existing courses, increasing interaction between the PHOE and ECE Departments, and improving opportunities for students in the field.

This certificate is designed to give the student a firm theoretical and practical working knowledge in the area of fiber optic devices, optical communications, networks and its applications. The main purpose is to couch these fundamentals in a context that serves as the backbone for device, components and sub-system development for use in high-

speed optical data and information links and networks. At the end of the program the student will be expected to:

- 1. Understand the fundamental operation characteristics of high-speed optoelectronic components, such as laser transmitters, light modulators and receivers and passive fiber optic components as connectors, couplers, filters, and switches.
- 2. Understand the technology and performance of analog and digital fiber optic links, optical amplification and optical wavelength division multiplexing and optical time division multiplexing networks.
- 3. Have hands-on working knowledge of the use of fiber optic test equipment and techniques used by industry and telecommunication companies to test the performance of optical fiber links and components, such as, optical time domain reflectometry, optical spectrum analyzers and optical bit error testing equipment.

The Certificate will consist of 20 credit hours of which 12 credit hours will be required courses. Students interested in pursuing this Certificate should contact an ECE/ PHOE certificate advisor (Professors Duree, Granieri, Alisafaee, Reza, Joenathan, Siahmakoun).

Required Courses

- ECE 310 Communication Systems
- OE 393 Fiber Optics and Applications
- OE 493 Fundamentals of Optical Fiber Communications

Elective Courses (two from the list)

Only courses not required for the student's major will count for electives in the certificate.

- ECE 380 Discrete Time & Continuous Systems
- ECE 410 Communication Networks
- ECE 414 Wireless Systems
- OE 360 Optical Materials
- OE 435 Biomedical Optics
- OE 450 Laser Systems and Applications

Power Certificate

Take all of the following courses:

- ECE 473 Control of Power Systems, Pre: ECE 470
- ECE 472 Power System Protection, Pre: ECE 470 & ECE 471
- ECE 471 Power System Analysis II, Pre: ECE 470
- ECE 470 Power System Analysis I, Pre: ECE 370
- ECE 371 Conventional & Renewable Energy Systems, Pre: ECE 204
- ECE 370 Electric Machinery, Pre: ECE 204
- ECE 204 AC Circuits, Pre: ECE203 with a grade of C or better and PH113
- ECE 203 DC Circuits, Pre: MA111 and PH112

SEMICONDUCTOR MATERIALS AND DEVICES CERTIFICATE

The Certificate will consist of 20 credit hours of which 12 credit hours will be required courses. Students interested in pursuing this Certificate should see a PHOE certificate advisor (Pfiester Latham, Siahmakoun, Syed and Wagner). Students taking solid state/ material science minor cannot take this certificate.

Required Courses

- 1. PH405 Semiconductor Materials and Applications -- 3R-3L-4C F Pre: PH113 or PH255 or PH265 or consent of instructor.
- 2. EP406 Semiconductor Devices and Fabrication -- 3R-3L-4C W Pre: PH405 or consent of instructor.
- EP410 Intro to MEMS: Fabrication and Applications -- 3R-3L-4C S Pre: JR or SR standing or consent of the instructor. or:

CHE440 Process Control 4R-0L-4C W Pre: CHE202

Electives

| COURSE | HOURS | COURSE TITLE |
|---------|-------|--------------------------------------|
| OE 450 | 4 | Laser Systems and Applications |
| OE 485 | 4 | Electro-Optics and Applications |
| PH 330 | 4 | Material Failure |
| PH 401 | 4 | Introduction to Quantum Mechanics |
| PH 440 | 4 | X-rays and Crystalline Materials |
| EP 408 | 4 | Microsensors |
| EP 411 | 4 | Advanced Topics in MEMS |
| ECE 351 | 4 | Analog Electronics |
| 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 |

| COURSE | HOURS | COURSE TITLE |
|----------|-------|---|
| 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.

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