

CMS 381 or equivalent (or concurrent enrollment in an internship).

390 Independent Study. F, I, S. Prerequisites: permission of the instructor.

## Dutch

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*Professor H. Aay (Frederik Meijer Chair of Dutch Language and Culture),  
J. Vos-Camy (chair)*

*Associate Professor H. De Vries (Queen Juliana Chair of the Language and Culture  
of the Netherlands)*

Programs for students wishing to minor or major in Dutch are worked out for them individually by the department advisor. A Calvin Studies in the Netherlands off-campus semester at the Free University of Amsterdam, primarily designed for science and engineering students, will also be open to students in the Dutch program beginning in Spring 2010. Interested students should contact the chairperson in September for details and information on available placements in this program. Semester programs, approved or endorsed by Calvin, are available to students in the cities of Leiden and Zwolle.

The cross cultural engagement requirement is met by the Dutch Interim Abroad (W 40).

### **DUTCH MAJOR**

(34 semester hours)

Dutch 101

Dutch 102

Dutch 201

Dutch 202

Six 300-level electives, one of which may be an approved Dutch-language interim in the Netherlands.

Courses taken on semester programs in the Netherlands may apply, provided that students meet with department chair and gain approval for specific courses in advance.

### **DUTCH MINOR**

(25 semester hours)

Dutch 101

Dutch 102

Dutch 201

Dutch 202

Two 300-level electives

An independent study or an approved interim in the Netherlands.

Courses taken on semester programs in the Netherlands may apply, provided that

students meet with department chair and gain approval for specific courses in advance.

### **NETHERLANDIC STUDIES MAJOR**

(33 semester hours)

Dutch 101

Dutch 102

Dutch 201

Dutch 202

Three 300-level Dutch courses, one of which may be an approved Dutch-language interim in the Netherlands.

Two courses from Art History 234, and then (optionally) Art History 237, an approved European History Course, an approved Religion course, Geography/Engineering and Dutch Landscapes Interim.

Courses taken on semester programs in the Netherlands may apply, provided that students meet with department chair and gain approval for specific courses in advance.

Prerequisite to a concentration in Dutch

is a minimum average of C (2.0) in Dutch 101, Dutch 102, Dutch 201, and Dutch 202. Completion of Dutch 202 meets the foreign language requirement.

## COURSES

**101 Elementary Dutch I** (4). F. An introductory course in the comprehension and use of spoken and written Dutch and an exposure to the people and culture of the Netherlands and Flanders, Belgium.

**102 Elementary Dutch II** (4). S. A continuation of Dutch 101.

**201 Intermediate Dutch I** (4). F. Further development of skills in speaking, listening, reading, and writing Dutch. Includes systematic grammar review and the introduction to finer points of grammar and idiomatic use of the language. Cultural topics are explored through film and short literary texts. Prerequisite: Dutch 102 or permission of the instructor.

**202 Intermediate Dutch II** (4). S. A continuation of Dutch 201. Further development of skills in speaking, listening, reading, and writing Dutch. Ongoing mastery of grammar and idiomatic use of the language. Cultural topics are explored through film and short literary texts.

**305 Dutch Literature I** (3). F. Study and discussion of several Dutch literary texts representative of the classical and modern periods of Dutch literature. Offered based on demand. See department chair.

**306 Dutch Literature II** (3). S. A continuation of Dutch 305.

**309 Netherlandic Civilization** (3). A study conducted in the English language of several important aspects of Netherlandic civilization: Literature, history, religion, art, architecture, social structure, and education. Offered based on demand. See department chair.

**390 Independent Study**. Prerequisite: Approval of department chair. *Staff*.

# Economics

*Professors R. Hoksbergen\*\*, K. Schaefer\*\*, J. Tiemstra, E. Van Der Heide,  
S. Vander Linde (chair)*

*Associate Professor A. Abadeer*

*Assistant Professor R. DeVries, B. Haney, S. McMullen*

The department has structured its major areas of study so that students may design programs that best prepare them for their chosen career fields. It offers three majors leading to a Bachelor of Arts degree — economics, a group concentration in the social sciences, and a group concentration involving mathematics and economics. With the help of their advisor, students may choose to focus their economics major to prepare them for careers in business, finance, international economics, international development, or graduate school. Group concentrations must form a coherent, planned program approved by an advisor.

The department offers economics minors that serve a variety of student needs: a general minor in economics or minors corresponding to specific concentrations in the Calvin business curriculum (finance, human resources, marketing, and operations management), as well as, international, quantitative, or teacher education (see below for details).

Only one interim course may serve as an elective for any major or minor in the department, and only if the interim course is designated as an elective by the department. The

department offers a variety of experiential learning options that can be integrated into any of the department's majors.

Prerequisite for admission to the economics majors or minors is a minimum grade of C (2.0) in Economics 221. The societal structures in North America core area is met by Economics 151, 221, 232, or 241; global and historical studies is met by Economics 237 or 337 and integrative studies is met by Economics 395.

### **ECONOMICS MAJOR**

Economics 221  
Economics 222  
Economics 325  
Economics 326  
Economics 343  
Economics 345 or 346  
Economics 395  
Two additional from Economics 330-346  
Two electives from economics or business courses

#### **Cognates**

Mathematics 143, 243, or 343-344  
Mathematics 132 or 171  
Information Systems 171

### **ECONOMICS MINOR**

Economics 221  
Economics 222  
Economics 325 or 326  
Three from Economics 232-346, including at least one 300 level course  
After taking Economics 221 and 222, students are encouraged to organize the additional four courses for the economics minor according to their area of academic interest as follows:

Finance: Economics 326 and three from 331, 338, 339, 343, 346  
Human Resources: Economics 325 and three from 326, 241, 232, 330, 345  
International And Global Study: Economics 325 or 326 and three from 237, 331, 337, 338, 345, 346  
Marketing: Economics 325 and three from 241, 330, 334, 345  
MBA Preparation: Economics 325, 326, 343 and one from 241-346  
Operations Management: Economics 325, 343 and two from 232, 326, 330, 334, 339, 345, 346  
Public Administration And Policy: Economics 325 or 326 and three from 232, 241, 330, 335, 339

Quantitative Analysis: Economics 325, 326, 343, and 345 or 346  
Small Business: Economics 325 or 326, and three from 232, 241, 330, 331

### **SOCIAL SCIENCE GROUP MAJOR— ECONOMICS EMPHASIS**

Economics 221  
Economics 222  
One from Economics 325-326  
Two from Economics 325-346  
Four courses from one of the social sciences (sociology, psychology, political science or history)  
Two electives from economics or business

#### **Cognates**

Mathematics 143, 243 or 343-344  
Information Systems 171  
One from Information Systems 151, 153, 221, 141, 271 or Computer Science 104, 108 or 112

### **SECONDARY EDUCATION ECONOMICS MINOR**

Economics 221  
Economics 222  
Economics 338  
Economics 339  
IDIS 375  
Six additional semester hours from within the department, one advisor approved interim may be included

### **SECONDARY EDUCATION SOCIAL STUDIES GROUP MAJOR**

Economics 221  
Economics 222  
Geography 110  
Geography 210  
History 151  
History 152  
History 229  
Political Science 101

Political Science 202  
 Interdisciplinary 205  
 Interdisciplinary 375  
 Interdisciplinary 359

Students pursuing the secondary social studies major must also complete a history major or a minor in economics, geography, or political science. Courses are allowed to overlap between the social studies major and the disciplinary major or minor.

### ELEMENTARY SOCIAL STUDIES GROUP MAJOR

Students must take two specified courses from each of the following four disciplines: economics, geography, history, and political science. (Specific course choices are listed in the *Teacher Education Program Guidebook*). In addition, students must complete a sequence of courses from one of these disciplines chosen in consultation with a social studies education advisor. Advisors: D. Miller, D. Howard, and R. Schoone-Jongen, History.

### ELEMENTARY SOCIAL STUDIES GROUP MINOR

Economics 221  
 Economics 222  
 Geography 110  
 One from geography 210, 230, 310, or 320  
 History 151 or 152  
 History 229  
 Political Science 101  
 Political Science 202

For information on the mathematics/economics group major, please contact the department chair

### COURSES

151 **Principles of Economics** (3). F and S. The institutions of the North American market economy are studied, examining the determinants of resource allocation, income distribution, prices, production, income and employment levels, and economic growth. Topics include international economic relations and the role of government in the economy. Christian ideas about justice, freedom, and stewardship are applied to economic questions. Students intending to major or minor in economics or business should not

take this course, but should take Economics 221 to satisfy this core requirement.

200 **Calculus Applications for Business** (1). F An introduction to differential calculus and optimization techniques used in business applications. The concept of changes at the margin and derivatives will be applied to problems in operations management, management decision theory and economic analysis. Students will also study constrained and unconstrained optimization and use it to solve problems in areas such as product pricing, production, capital budgeting, and assessing risk in markets. This course is for business students, to normally be taken concurrently with Mathematics 201 and Economics 221 (by students not completing another calculus course). This course does not satisfy the calculus requirement for economics majors.

221 **Principles of Microeconomics** (3). F and S. This course involves a study of the institutions of mixed-market economies such as those of North America, their role in resource allocation, and the determination of prices, outputs, and income distribution. Topics include the role of the government in the economy and environmental impact of economic activity. Christian views concerning justice, freedom, stewardship, and the nature of human beings and society are applied to economic analysis and issues.

221H **Principles of Microeconomics** (3). The honors section of "Principles of Microeconomics" is similar to other sections regarding content and general course requirements. However, the honors section will be conducted with greater opportunities for group discussion and classroom reporting of student research results. This course meets a core requirement in the societal structures category. Enrollment in honors Economics 221 is limited to 20 and is normally not open to first-year students. Not offered 2009-2010.

222 **Principles of Macroeconomics** (3). F and S. A continuation of Economics 221. A study and evaluation of the determination of national income, including analysis of consumer spending and saving patterns, business investment, government spending, taxation, monetary policy, unemployment, and inflation. The course includes an introduction to international trade and finance. Prerequisite: Economics 221.

**232 Environmental and Natural Resource Economics (3).** F A study of environmental problems in relationship to Christian stewardship, sustainability, economic efficiency, and justice. Topics include economic activity as a source of environmental problems, measurement of the costs and benefits of environmental policies, and design and evaluation of public and business policies to address these problems. No prerequisite.

**237 Regional Economies of the World (3).** F and S. This course focuses on the economies of a particular region of the world. African, Asian and Latin American economies are studied on a rotating basis. The course begins with a study of basic differences in economic systems and institutions of modern economies. These concepts are then applied to more detailed historical study of a number of key regional economies. The possibility of a distinct regional development model is considered. This course satisfies the global and historical studies core requirement if a student has previously taken a world history class. Prerequisite: Economics 221 and 222 or Economics 151.

**241 Health Economics and Health Policy (3).** S. An introduction to economics in the context of a study of health economics and health policy, with detailed focus on the U.S. health care system. The intent of the course is to develop an understanding of economic principles that can be used with other criteria to evaluate the historical and future direction of the U.S. health care system. Topics include efficiency and the equity of resource allocation, ethical perspectives of health care access, history and reform of health care policy, and the development and evolution of insurance, hospital and health care provider markets. Students will be challenged to further develop and apply a reformed Christian world-view to these issues. This course is recommended for students seeking a professional career in health care management, human resources, medicine, mental health professions, nursing or public policy. Not open to first-year students.

**325 Managerial Economics/Intermediate Microeconomics (4).** F and S. An intermediate-level study of microeconomic theory emphasizing applications to managerial decision-making in such areas as market and risk

analysis, demand forecasting, production and cost analysis, product pricing, profit planning, and capital budgeting. Goals of firms and the use of economic theory in achieving them are examined and evaluated. Prerequisites: Economics 221; Information Systems 171; Mathematics 143, 243, or 343; and Economics 200 (business majors) or Mathematics 132 or 161 (economics majors).

**326 Business Cycles and Forecasting/Intermediate Macroeconomics (4).** F and S. An intermediate-level study of macroeconomic theory emphasizing analysis of general business activity and the implications of changing business conditions for business and public policy. Basic forecasting techniques are explained and the use of forecast information in firm and individual decision-making are evaluated. Computer lab work is used to demonstrate the application of economic theory to business planning and forecasting. Prerequisites: Economics 221 and 222, Information Systems 171, and Mathematics 143, 243, or 343.

**330 Urban Regional Economics (3).** F This course initially introduces students to regional economic and location theory and then explores regional issues of metropolitan development as they relate to national economic growth. Basic concepts of the study that will be examined include location determinants, land use, inter-regional economic flows of people and resources, exports, infrastructure, and transport systems. Tools of national and regional forecasting and the concept of social accounting systems will be taught to help analyze and develop appropriate policy by business firms and governments at different levels. The course will illustrate applications of theory and policy by considering, typically, the West Michigan economy. Questions concerning economic health of downtown districts, transportation problems, urban sprawl, the role of lending agencies and realtors, and local governmental cooperation with business will be considered in the course. Prerequisites: Economics 221 and 222.

**331 Money and Banking (3).** S. A study of the principles of money, banking, and credit with emphasis on monetary theory and policy and their role in domestic and international economics. Prerequisite: Economics 221 and 222.

**334 Industrial Markets and Public Control** (3). F A study and evaluation of business strategies in imperfectly competitive markets, including entry barriers, pricing, product differentiation, vertical integration, and mergers. Examination of relevant public policies, such as antitrust law and utility regulation. Prerequisite: Economics 221 and 222.

**335 Labor Economics** (3). S. A study of labor markets and their relationship to the economy as a whole, including labor-force participation, human-capital formation, wage theory, discrimination, unemployment, income distribution, labor unions, and related public policies. Prerequisite: Economics 221 and 222.

**337 World Poverty and Economic Development** (3). F and S. A study of the characteristics of poor nations in many regions of the world, and of factors that cause and influence economic development within countries. After examining conditions within poor nations, students analyze theories of economic growth and economic development. Subsequently, the course investigates differences and similarities in human and capital resource endowments, production, and trade relations. Problems, possibilities, and policies are analyzed in each of these topic areas. Prerequisites: Economics 221 and 222.

**338 International Economics** (3). F A study of international economic relations, stressing the fundamentals of trade theory, the balance of payments, problems of international disequilibrium, trade barriers, and efforts to promote international economic stability and growth. Prerequisite: Economics 221 and 222.

**339 Public Finance** (3). S. A study of the economic effects of government spending and taxation on resource allocation and on the distribution of income. Students analyze the economic role of government, and current policy issues and the political process regarding taxation and government spending. Prerequisite: Economics 221 and 222. Not Offered 2009-2010.

**343 Quantitative Economics and Econometrics** (3). F An introduction to econometric methods that are frequently used in applied economic research and business practice. Emphasis on creating, interpreting, and critically

evaluating empirical results. Topics include the classical linear regression model, functional form, dummy explanatory variables, binary choice models, heteroskedastic and autocorrelated disturbance terms, and an introduction to simultaneous-equation and time-series models. Students learn to write their own programs in a major statistical programming language. Prerequisites: Mathematics 132 and 143 or their equivalents.

**345 Advanced Topics in Microeconomics** (3). F This course provides students with a deeper understanding of microeconomic theory than at the intermediate level. Students will be exposed to recent topics in microeconomics, including game theory, the economics of information, and behavioral economics. They will also learn to build economic models to analyze economic phenomena. Prerequisites: Economics 325 (including the statistics and calculus cognates). Not offered 2009/2010.

**346 Advanced Topics in Macroeconomics** (3). S. This course provides students with a deeper understanding of macroeconomic theory, beyond the intermediate level. Economic modeling will be used to gain insight into important macroeconomic issues, including economic growth of nations, consumption, investment, inflation, unemployment, and government macroeconomic policy. International interrelationships, decisions made under uncertainty, and decisions made across time periods will also be included in the analysis. Prerequisites: Economics 326 (including the statistics and calculus cognates).

**390 Independent Study**. F, I, and S. Prerequisite: Permission of the department chair.

**395 Economics Seminar** (3). F This seminar course considers the history of economic thought during the last two millennia. This involves a careful consideration of major historical schools of thought about economic culture, beginning with the classical civilizations and ending with contemporary methodological approaches to economics. Prerequisites: Senior economics major status; biblical foundations I or theological foundations I, developing a Christian mind, and philosophical foundations.

# Education

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Professors T. Hoeksema, C. Joldersma†, R. Keeley† (chair), J. Simonson, R. Sjoerdsma, Associate Professor A. Boerema, D. Buursma, J. Kuyvenhoven, J. Rooks Assistant Professors K. Dunsmore†, P. Stegink, M. Terpstra, S. Verwys Adjuncts B. Hekman, J. Shortt

## Undergraduate Teacher Education Program

The undergraduate teacher education program is described in detail in the *Teacher Education Program Guidebook*, which is available on the Education department's Web site. In Michigan, teachers are generally certified to teach at the elementary (K-8) or secondary (6-12) level. There are a few specialty areas in which students can be certified to teach in grades K-12 (e.g. art, foreign languages, music, physical education, and special education). All teacher education students are required to complete the liberal arts core and a series of education courses. In addition, students are required to complete a major and minor or multiple minors in content specialty areas (e.g. history, language arts, early childhood education, etc.). Students who wish to teach at the middle school level are advised to follow the elementary teacher education core requirements and choose two minors that they would like to teach in a middle school setting (e.g., language arts and integrated science).

Since teacher education students have a complex and comprehensive preparation program, they should seek assistance in choosing appropriate courses as early as possible. Students who are interested in teacher education should inform the office of academic services so that they can be assigned to an advisor who is knowledgeable about education program requirements. Since some core courses are designed in particular for education students, programs must be carefully planned. It is especially important for students who are considering endorsements in special education, early childhood education, bilingual education, or English as a second language to work with the advisor in their specialty area early in their programs.

Normally, students apply to be admitted into the teacher education program during their sophomore year. Criteria for admission to the teacher education program are described in the *Teacher Education Program Guidebook*. Students must also fulfill particular criteria for admission to directed teaching (the full-time student teaching semester) and for certification. All of these criteria are described in the guidebook.

Specialized core requirements are listed in the *Teacher Education Program Guidebook*. Education course requirements are described in this section of the catalog. Major and minor requirements are described under the appropriate department. The specialty area majors and minors offered are listed below. Note that most group majors and minors are associated with multiple departments. Detailed descriptions of the education program and specialty area requirements can also be found in the guidebook.

Practicum experiences for Education 202, 303, 330, 343, 344, 345, 346, and 347 occur at a variety of sites in the greater Grand Rapids area. Students are responsible for their own transportation to those settings. Students may be able to arrange a car pool or use the city bus line.

## Post Baccalaureate Non-Degree Program Leading to a Michigan Provisional Teacher Certificate

This program is designed for students who have graduated with a bachelor's degree from an accredited institution without having obtained a teaching certificate. To be eligible for this program, students must have a grade point average of 2.5 or above and two letters of recommendation. Students must complete the required courses in the education sequence for elementary or secondary certification including a semester-long directed teaching experience. Certification requirements for specialty area majors and minors (including successful completion of state certification tests) must also be met.

Only courses in which a grade of C– or higher is earned can be used to meet program requirements. Requests for admission to this program should be addressed to the Education department.

Special Note: The State of Michigan has recently put new standards into effect for elementary education students. Members of the education program are working to determine what those changes will mean for our program but, at the time of this printing, that work is not yet complete. The new requirements, however, may affect students hoping to graduate as soon as May 2012. The department will notify students as soon as possible of any changes.

### MAJOR AND MINOR EDUCATION CONCENTRATIONS

Some of these majors and minors are available for K-12, secondary, or elementary only. See the department's section of the catalog to determine the certification levels available and to obtain a list of required courses for these majors and minors.

- Art
- Bilingual Spanish
- Biology
- Chemistry
- Communication arts and sciences
- Computer science
- Early childhood education (see education)
- Earth/space science (see geology)
- Economics
- English
- English as a second language
- Fine arts group (see art, music or communication arts and sciences)
- French
- Geography
- German
- Health education (see HPERDS)
- History
- Integrated science (see science education studies)
- Language arts group (see English or communications arts and sciences)
- Latin (see classical languages)
- Mathematics
- Music
- Physical education
- Physics
- Political science
- Psychology
- Religion
- Social studies group (see history, economics, political science or geography)
- Sociology

- Spanish
- Special education—cognitive impairment

A comprehensive list of departmental advisors for each concentration can be found in the *Teacher Education Program Guidebook*.

### ELEMENTARY EDUCATION COURSES

- Education 102
- Education 202
- Education 302
- Education 303
- Education 305
- Education 309
- Education 322
- Education 326
- Education 345
- Education 398
- Interdisciplinary 205
- Science Education Studies 313
- Mathematics 221
- Mathematics 222
- Physical Education 221
- Physical Education 222

### SECONDARY EDUCATION COURSES

- Education 102
- Education 202
- Education 302
- Education 303
- Education 307
- Education 346
- Education 398
- Interdisciplinary 205

### SPECIAL EDUCATION MAJOR (COGNITIVE IMPAIRMENT)

Advisor: T. Hoeksema

- Biology 115
- Psychology 151
- Psychology 201
- Psychology 213
- Education 306

Education 310  
Education 330  
Education 347

### **EARLY CHILDHOOD MINOR**

*Advisor: S. Verwys*

Education 202  
Sociology 304  
Education 236  
Education/Communication Arts and Sciences 311  
Education 337  
Education 339  
Education 343  
Education 344

### **UNDERGRADUATE COURSES**

**102 Introduction to Education** (1) F and S. This course serves as an introduction to the discipline of education and the teaching profession. As such, it provides the initial framework for subsequent education courses, introducing students to pedagogy and its empirical basis, to issues of curriculum and standards, and to the organization of schools in the United States and beyond. The course affords students the opportunity to relate theory to practice as a companion field experience is a required component of the course. This course must be satisfactorily completed as a condition of program admission. Prerequisite: completion of one semester of college study.

**202 The Learner in the Educational Context: Development and Diversity** (3) F and S. This course will help students develop insight into the development of the mind, identity, and perspective of all learners, including multiple domains of diversity and many alternate ways of being, doing, and seeing, including what is typically labeled as “exceptionality.” Students will explore and analyze psychological, physical, social, culture and moral/spiritual facets of development as well as their interplay with the social environment of the learner and their impacts in the classroom. Through lectures, readings, class assignments, a service-learning experience, and a case study, the class will examine psychological, educational, biological, and socio-cultural theory through the lens of a reformed Christian perspective. There is a fifteen hour outside of class field placement required as part of this course. This course must be satisfactorily completed as a condition of

program admission. Prerequisite: completion of Education 102.

**236 The Young Child in an Educational Setting** (3). F A review and critique of the basic theories of child development. Observation and intensive analysis of the development of a particular child in a preschool setting as related to the major theories and to the appropriate facilitation of development.

\*Students seeking certification must be admitted to the teacher education program and be in good academic standing before beginning any 300-level course in the department.

**302 Curriculum and Instruction for Diverse Learners** (4) F and S. This course will help students develop an increased understanding of the complex issues surrounding learning theory and its impact on instruction in diverse educational contexts. Students will explore how an understanding of the learner, the curriculum, and the context shape instructional practice. They will learn how to engage in a pedagogical cycle that includes planning, implementation, evaluation, and reflection with a focus on meeting the needs of all learners. Students will also explore ways in which new teachers can develop and maintain a transformative vision. All of these areas will be examined through the lens of a reformed Christian perspective. An extensive practicum will assist students in linking theory and practice in a classroom setting. Prerequisites: Education 102, 202, admission to the teacher education program. (See the *Teacher Education Guidebook* for admission requirements.) Must be taken concurrently with Education 303.

**303 Curriculum and Instruction: Practicum** (3) F and S. Must be taken concurrently with Education 302. See description above.

**305 Teaching Social Studies in the Elementary and Middle School** (2). F and S. A study of perspectives, content, methods, and materials in teaching the social studies in the elementary school. Students will analyze perspectives and determine major goals and themes for teaching the social studies. They will study and analyze the contributions of the various disciplines to the social studies curriculum. Students will examine materials and learn and practice methods for teaching the social studies. Biblical principles, which offer direction

for human interactions in society, will be considered. Prerequisites: Education 302/303 or permission of the instructor.

**306 Introduction to Cognitive Impairment (3).** F A comprehensive study of the characteristics of persons who have an intellectual disability. Historical and contemporary perspectives on mental retardation will be explored, as will common causes, definitional issues, and interventions. While special attention is given to the needs of persons with retardation as learners, the course examines the entire lifespan and functioning in a variety of settings besides the school, such as the church, workplace, and neighborhood. A Christian view of persons, community, and discipleship, along with the concept of normalization/social role valorization, are integrating elements in the course. Prerequisite: Education 202 or permission of the instructor.

**307 Reading/Literacy in the Content Area (3).** F and S. This course examines the nature and function of literacy in the secondary curriculum. Specifically this course will examine the reading and writing practices that support the ways of knowing and doing characteristic of secondary school subject areas. The course will include: analysis of the factors which affect comprehension and composition of content area materials; examining pedagogical strategies that support diagnosis as well as instruction in the literacy skills common to all content areas; strategies for supporting full participation and inclusion of students who display the wide range of ability found in the average secondary classroom; exploring the relationship between discipline based inquiry, literacy development, and educational goals and practices. There is a field placement component as part of this class. Prerequisites: Education 302/303 or permission of the instructor.

**309 Teaching Religion to Children and Adolescents (2).** F and S. A study of perspectives, content, methods, and materials in teaching religion to children and adolescents. This includes pedagogy appropriate for public and non-public schools and other settings and evaluation of methods and materials. Prerequisites: Education 302/303, permission of the instructor or declaration of youth ministry minor.

**310 Assessment in Cognitive Impairment (3).** S. A study of the foundational concepts and basic terminology needed to assess students with intellectual disability. Skill will be developed in selecting, administering, and interpreting both formal and in-formal, norm-referenced as well as criterion referenced and curriculum-based assessment instruments, for the purpose of developing individualized educational plans. Corequisite: Education 347.

**311 Child Language Development (3).** S. See Communication Arts and Sciences 311.

**322 Introduction to Methods of Teaching Reading: Elementary (3).** F and S. A study of the nature of the reading process; an introduction to the various processes; an introduction to the various approaches to the teaching of reading with an emphasis on the basal approach; a presentation of instructional strategies appropriate to a developmental reading program; and an analysis of the organization and management of a classroom reading program. Prerequisites: Education 302/303 or permission of the instructor.

**326 Reading/Language Arts in the Elementary School (3).** F and S. This course will present reading as a language art and demonstrate the relationship of language arts to the various subjects in the elementary school. Students will learn strategies and techniques for assessing and differentiating instruction to meet the wide range of reading and writing levels found in elementary classrooms. Prerequisite: Education 322 or permission of the instructor.

**330 Curriculum and Instruction: Cognitive Impairment (3).** F A study of the various curricula, instructional materials, and teaching methods appropriate for learners who have mental impairments. Research-based general principles of instruction are reviewed as well as specific methods for teaching domestic, vocational, community living, recreation/leisure, and functional academic skills. Strategies are learned for generating curriculum, evaluating published curricula, and for developing individualized education programs. Includes a practicum of two half-days per week in local school programs serving students with cognitive impairment. Prerequisites: Education 202, 302/303, and 306 or permission of the instructor.

- 337 Curriculum Theory and Development: Early Childhood Education (3).** S. An evaluation of the major approaches to development of a curriculum for early childhood education (up to age eight), the underlying assumptions of each approach, and the appropriateness of each approach for children. Included is a model for curriculum development and opportunity to implement the model for early education. Prerequisite: Education 302/303.
- 339 Current Issues in Early Childhood Education (3).** S. An examination of support systems for the young child, including developing relationships; issues and trends in child advocacy public law and policy; administration and organization of early childhood programs; and assessment issues.
- 343 Early Childhood Education: Preschool Field Experience (3).** F and S. A field experience in a preschool setting that meets state requirements for the endorsement. Provides for analysis of teaching methods, materials, and classroom organization as they relate to the early childhood setting. Prerequisites: Education 236, 337, 339, and Sociology 304.
- 344 Early Childhood Education: Kindergarten Field Experience (3).** F and S. A field experience in a kindergarten setting that meets state requirements for the endorsement. Provides for analysis of teaching methods, materials, and classroom organization as they relate to the early childhood setting. Prerequisites: Education 236, 337, 339, and Sociology 304.
- 345 Directed Teaching: Elementary (12).** F and S. Students participate in a full-time supervised student teaching experience. Prerequisites: GPA of 2.5, passing scores on the Michigan Test for Teacher Certification—Basic Skills, completion of education courses, and appropriate recommendations from the education and major/minor departments. See the *Teacher Education Program Guidebook* for additional requirements. Includes a weekly seminar.
- 346 Directed Teaching: Secondary (12).** F. Students participate in a full-time supervised student teaching experience in their major. Secondary mathematics students student teach during the fall semester. Secondary history and physical education students student teach during the fall or spring semester. Secondary science students (all of the sciences) student teach only during the spring semester. All other secondary students student teach during the spring semester. Prerequisites: GPA of 2.5, passing scores on the Michigan Test for Teacher Certification-Basic Skills, completion of education courses, appropriate recommendations from the education and major/minor departments, and concurrent enrollment in a departmental Seminar, Education 359. See the *Teacher Education Program Guidebook* for additional requirements.
- 347 Directed Teaching: Cognitive Impairment (12).** S. Full-time, supervised student teaching in a school program serving students with mild or moderate levels of cognitive impairment. A minimum of ten weeks, including at least 360 clock hours of observation and participation, is required. Includes a biweekly seminar, which engages students in critical reflection on their experience in applying theory to practice in the student teaching context. Prerequisites: Good standing in the teacher education program, passing scores on the Michigan Test for Teacher Certification-Basic Skills, completion of all required education courses, and appropriate recommendations. See the *Teacher Education Program Guidebook* for additional requirements.
- 348 Directed Teaching: Elementary - English as a Second Language .** See ESL advisor for more information.
- 349 Directed Teaching: Secondary - English as a Second Language .** See ESL advisor for more information.
- 398 Integrative Seminar: Intellectual Foundations of Education (3).** In this course students examine education in its context as a life practice. It involves inquiry into and critique of the philosophical assumptions, historical developments, and social settings that shape the beliefs and practices informing schools as social institutions and education as cultural practice. Throughout the course, students are completing their own faith-based philosophy of education. Prerequisites: junior or senior standing; Education 302/303; biblical foundations I or theological foundations I, developing a Christian mind, and philosophical foundations.

IDIS 205 **Societal Structures and Education** (3). F and S. An examination of the interaction between education and the other systems and institutions (e.g., political, economic, and cultural) that shape society. This course will examine how education is shaped by and is reshaping these systems and institutions. Particular attention will be given to the impact of race, class, and gender on schooling and society. Community-based research projects will challenge students to examine these issues in real-life contexts as well as introducing them to social science research methodology. Christian norms, such as social justice, will shape this critical analysis of the interaction between education and society. This class is appropriate for all students who are interested in education and society and meets a core requirement in the societal structures category.

### **Graduate Teacher Education Program**

Calvin College offers Master of Education (MEd) programs in curriculum and instruction, educational leadership, literacy and learning disabilities. In addition, post-baccalaureate, non-degree programs are available for obtaining the Michigan Professional Teaching Certificate (18 hours of coursework beyond initial certification) and state endorsements for specialized areas of education.

#### **Master of Education Degree**

The Master of Education (MEd) programs serve elementary and secondary teachers and administrators who want advanced professional training and who need to satisfy the requirements for continuing certification or additional endorsements.

Calvin's MEd is designed especially for teachers who are already certified and experienced in classroom teaching or administration and who wish to attend a Christian college where academic excellence is pursued in the light of Christian commitment. The MEd provides college graduates with an opportunity to integrate an authentic Christian perspective with a broader or deeper range of knowledge and insight into the professional role of the teacher or administrator. Information about MEd programs can be found in the graduate program catalog or on the graduate studies Web site.

Students who wish to learn more about specif-

ic specialty areas in the MEd program should meet with one of the following advisors: J. Simonson, curriculum and instruction; A. Boerema, educational leadership; J. Rooks, literacy; or D. Buursma, learning disabilities.

#### **Endorsement Program**

The Endorsement Program at Calvin allows certified teachers to fulfill the requirements of the Michigan Professional Teaching Certificate, gain highly qualified status, or obtain additional expertise in a specialty area. The state of Michigan requires a minimum of 18 semester hours of coursework beyond initial certification and 3 years of successful teaching experience before a teacher can be recommended for a Professional Teaching Certificate. The state regulations for highly qualified status are available in the education department. The endorsement program allows participants to add a level of teaching certification to their certificate (e.g. elementary to a secondary certificate) or to add a subject endorsement to their certificate. Calvin offers endorsements in early childhood, English as a second language, learning disabilities, cognitive impairment, and bilingual education, as well as every major and minor offered at the undergraduate level. Courses taken in this program may be transferable to a master's degree at a later time if they are applicable to a particular concentration.

Courses in the endorsement program must be chosen in consultation with an appropriate departmental advisor at the time the program is initiated. Students who graduated from and were recommended for the provisional certificate by Calvin must take at least 6 semester hours of the program at Calvin. All others must take at least 9 semester hours at Calvin. Previous course work, as well as planned selections, must be evaluated by this advisor. Only courses with a grade of C+ (2.3) or higher will be applied to program requirements. Also, students adding subject endorsements or elementary certification must pass the Michigan Test for Teacher Certification for those areas.

Requirements for admission to the program, transfer of credit, and degree requirements are described in detail in the graduate program catalog, which can be obtained from the Education department office, the office of academic services or online on the graduate studies Web site.

# Engineering

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Professors R. Brouwer, R. De Jong, L. De Rooy, G. Ermer, \*M. Heun, R. Hoeksema, E. Nielsen, P. Ribeiro, A. Sykes, S. VanderLeest (chair), W. Wentzheimer  
Associate Professors, J. Jewett Van Antwerp, J. Van Antwerp, D. Wunder  
Assistant Professors A. Si

Calvin College offers a Bachelor of Science in Engineering degree (BSE) with concentrations in chemical, civil and environmental, electrical and computer, and mechanical engineering. The engineering program is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 - telephone: (410) 347-7700.

## *Engineering (BSE)*

Engineering is a design-oriented profession applying the principles of mathematics, science, economics, ethics, social sciences, and humanities with judgment to the utilization of energy and materials for the benefit of humanity. The recommended first semester curriculum is Chemistry 103, Mathematics 171, Engineering 101, 181 and English 101. Students interested in engineering should consult with the department chair, S. Vanderleest.

## **MISSION OF THE CALVIN COLLEGE ENGINEERING DEPARTMENT**

Within the mission of Calvin, the engineering department responds to the Creator's call to be agents of renewal by learning to design responsible technologies that serve the needs of the world. The mission of this department covers the faculty, staff, and students who together seek to build God's kingdom in the areas of engineering and technology.

### *Teaching*

The primary mission is for students and faculty to explore not only the fundamental technical concepts of engineering (such as design principles and problem-solving), but also to place that learning in a broader interdisciplinary and liberal arts context. All teaching is marked by a strong emphasis on responsible design that builds upon a foundation of faith in Jesus Christ. Students graduating with a BSE degree from Calvin will be:

- Kingdom servants whose Christian faith leads them to engineering careers of action and involvement, to personal piety, integrity, and social responsibility, and to leadership with a prophetic voice advocating appropriate technologies;
- Firmly grounded in the basic principles and skills of engineering, mathematics, science, and the humanities, for correct, perceptive, and sensitive problem assessment at a level appropriate for entry level professional work and graduate studies;
- Equipped to creatively move a project from problem statement to final design utilizing the interdisciplinary and interdependent character of the engineering profession.

### *Research & Scholarship*

The engineering department serves God by engaging both the profession and the general public through research and consulting that enhances the primary mission of teaching. Scholarship includes research in the engineering sciences; the design process; project management; engineering education; engineering ethics; and the relationships among engineering, technology, and the broader society.

### *Community Service*

Individuals in this department use technological gifts and skills to care for and serve neighbors locally and globally. Community service enhances the primary mission of

teaching and includes service-learning, involvement in mission projects, and consultation with groups needing engineering expertise.

The engineering program has a strong emphasis on design. Here the student meets the challenging value and technical issues that arise when societal problems are dealt with through technology. The design experience starts with several projects in the first two years, which focus on societal problems and issues, and which emphasize conceptual design, creativity, and teamwork. Design experiences are then integrated into each concentration by way of specific courses or projects. Finally, the design experience is completed by means of a capstone design project course sequence during the senior year. Within this design perspective, students are aided in the development of a thorough Christian understanding of technology and its applications.

Each of the four concentrations in the engineering program has two or three major themes or emphases. The chemical engineering concentration has emphases of chemistry and chemical processing. The civil and environmental engineering concentration has emphases of hydraulics, structures, and environmental. The electrical and computer engineering concentration has emphases of digital systems and analog circuits. Finally, the mechanical engineering concentration has emphases of thermal systems and machine design.

The curriculum described above is designed so that students will achieve the following outcomes. Calvin's engineering program will demonstrate that its graduates have:

- (a) An ability to apply knowledge of mathematics, science, and the engineering sciences as appropriate guidelines for design decision making,
- (b) An ability to design and conduct experiments, as well as analyze and interpret data to extract meaning,
- (c) An ability to design a system, component, or process to meet desired needs and to produce a prototype or model which can effectively test the basic principles of the design,
- (d) An ability to function on multi-disciplinary teams,
- (e) An ability to identify, formulate, and solve engineering problems using fundamental principles,
- (f) An understanding of professional and ethical responsibility from a Christian, holistic perspective,
- (g) An ability to communicate truthfully and effectively,
- (h) The broad education necessary to understand the impact of engineering solutions in a global and societal context including an understanding of Christian stewardship of resources,
- (i) A recognition of the need for, and an ability to engage in life-long learning, to aid in the fulfillment of their calling,
- (j) Engaged contemporary issues demonstrating how their Christian faith relates to their profession,
- (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice to develop responsible technologies, and
- (l) Significant exposure to the engineering profession.

#### Model High School Program

- 4 years of mathematics, including at least pre-calculus (AP Calculus and AP Statistics if possible)
- 4 years of science, including 1 year each of biology, chemistry, and physics
- 2 years of a foreign language
- 4 years of English
- CAD, drafting, or other industrial design courses are recommended

- Introduction to computer programming is recommended

**Admission:** Students follow a common program for the first two years. Late in the second year, they apply for admission to a concentration in the engineering program. The minimum requirements for admission to the program are:

- Completion of Chemistry 103, Computer Science 104, Mathematics 171, 172, 231, 271, Physics 133 and 235 with a minimum grade of C-;
- Completion of Engineering 101, 106, 181, 202, 204, and 209 with a minimum grade of C-;
- Completion of 16 hours of the required humanities courses
- Submission of résumé with application for admission to concentration
- Attendance at an engineering internship workshop
- Have a minimum cumulative GPA of 2.30
- Credit for Engineering 294, engineering seminar

Students must apply for admission to a concentration in the engineering program during the semester in which they are completing the required courses listed above. Admission to a BSE concentration is required for a student to enter 300-level engineering courses.

**Conditional Admission:** Conditional admission is available to assist certain students. Students who wish to take 300-level courses, but who have not completed the required courses with the stipulated minimum grade and/or who have not achieved the minimum required cumulative grade point average may be given conditional admission to the program. Conditional admission is granted at the discretion of the department chair. Conditional admission is normally granted as long as students do not have more than 8 semester hours of course deficiencies and only if their cumulative grade point average is no less than 2.20. Furthermore, the student's GPA must be raised to no less than 2.30 and all course deficiencies must be removed within the period designated by the chair (normally not exceeding one year). Students who receive conditional admission and then fail to meet these conditions within the designated time period are not eligible to reapply for admission to the program at a later date. As an alternative to conditional admission, students may delay taking 300-level courses until they have met all requirements for regular admission to the program.

**Graduating with Honors:** Those wishing to graduate with honors in engineering must meet the following requirements:

1. Have a minimum cumulative GPA of 3.5 and a total of six honors courses (18 hours minimum) overall, including at least two honors courses outside the major; at least two honors courses in engineering (except Engineering 101, 181, 185, 285, 294, 337, 339, 340, 382, 385, 387, 390, and 394) with a minimum grade of A- (at least one of the engineering courses must be a 300-level course).
2. Receive credit for Engineering 385: "Engineering Internship", or Engineering 387: "International Engineering Internship."

Since the Engineering department does not regularly offer honors sections, the honors courses in engineering are taken by special arrangement with the course instructor.

**International Concentration Designation:** Students may receive an international designation to their concentration (e.g., "BSE International Mechanical Concentration") by completing two of the following four items:

1. Complete an international engineering interim course.
2. Receive credit for an international internship and demonstrate some ability to speak the language of their internship country.

3. Receive credit for an international engineering summer program.
4. Receive credit for an international engineering semester program.

Other procedures and activities may qualify for the international designation. For additional details, please contact the department chair or the department internship coordinator.

**Transfer Student Admission:** Students wishing to transfer from another school should apply to the office of admissions. In general, transfer students must meet the same course requirements as students who begin their programs at Calvin. No course completed with a grade below C (2.0) will receive transfer credit.

Transfer students must arrange for an analysis of transcripts by the department chair well in advance of course advising. In addition, those who wish to take 300-level courses in their first semester at Calvin must:

1. Have a 2.5 grade point average at their previous school.
2. If requested, provide a letter from that school indicating that the student was in good academic and personal standing.
3. Receive either conditional admission or regular admission or possibly special permission from the chair.

Calvin's engineering program emphasizes the integration of Christian faith and a professional engineering education. This integration takes place in many ways. For this reason, a student seeking a BSE degree from Calvin should be part of the program for the equivalent of no less than four semesters as a full-time student at Calvin. It is also stipulated that at least one non-technical course be taken for each semester at Calvin.

**Notes Regarding Admission and Graduation:** All students must display a high degree of personal integrity to be recommended for admission. This is demanded by the nature of engineering as a profession. After admission to the engineering program the student must continue to make adequate progress toward fulfilling graduation requirements. A grade below C- in a 300-level engineering course is an example of inadequate progress, and will require repeating the course. 300-level engineering courses may be repeated only once. A student's admission to the program will be revoked if the student fails to show adequate progress. In addition to an overall, college-wide grade point average of 2.0, the student must obtain a grade point average of 2.0 in all engineering courses completed at Calvin to be eligible to graduate.

**Advisory Council and Professional Societies:** The Engineering department is served by an advisory board, the Calvin Engineering Advisory Council (CEAC), consisting of engineers from local industries, which meet semi-annually to review the program and give advice from an industrial perspective. The council is currently co-chaired by Mr. Ron Plaisier of Pfizer Corporation and Mr. Mark Michmerhuizen of JCI Corporation. Calvin Engineering Faculty are members of a wide range of professional societies. Calvin College has student chapters of ASCE, ASME, and IEEE.

**BACHELOR OF SCIENCE IN  
ENGINEERING**

(26 semester hours)

- Engineering 101
- Engineering 106
- Engineering 181
- Engineering 202
- Engineering 204
- Engineering 209

- Engineering 294
- Engineering 339
- Engineering 340
- Engineering 394

**Technical Cognates**

- (32 semester hours)
- Business 357
  - Chemistry 103

Computer Science 104  
Mathematics 171  
Mathematics 172  
Mathematics 271  
Mathematics 231  
Physics 133  
Physics 235  
Approved statistics course

### **Humanities Courses**

(31 semester hours)  
Interdisciplinary 149  
Interdisciplinary 150  
English 101  
Health and fitness core  
History 151 or 152  
Philosophy 153  
Religion 121 or 131  
Economics 221 or 151  
Literature core  
The arts core  
Interdisciplinary 102 or Communication  
Arts and Sciences 101  
Cross-cultural engagement  
One year of a foreign language (exemption  
for students with at least 2 years of high  
school foreign language with a C or bet-  
ter each term)

*Students must meet the requirements of at  
least one of the four concentrations listed  
below:*

### **Chemical Engineering Concentration- Chemistry and Chemistry Processing Emphasis**

(44 semester hours)  
Engineering 303  
Engineering 312  
Engineering 330  
Engineering 331  
Engineering 335  
Engineering 337  
Engineering senior special topics interim  
Engineering 342  
Chemistry 261  
Chemistry 262  
Chemistry 317  
Chemistry elective

### **Civil and Environmental Engineering Concentration-Hydraulics, Structures and Environmental Emphasis**

(42 semester hours)  
Engineering 305

Engineering 306  
Engineering 319  
Engineering 320  
Engineering 326  
Engineering senior special topics interim  
Engineering elective  
At least two from Engineering 308, 321 or  
327  
Advanced mathematics/basic science elec-  
tive  
Advanced mathematics/basic science/engi-  
neering elective

### **Electrical and Computer Engineering Concentration-Digital Systems and Analog Circuits Emphasis**

(42 semester hours)  
Engineering 302  
Engineering 304  
Engineering 307  
Engineering 311  
Engineering 325  
Engineering 332  
Engineering senior special topics interim  
Engineering elective  
Advanced mathematics/basic science elec-  
tive  
Advanced mathematics/basic science/engi-  
neering elective  
Computer science 112

### **Mechanical Engineering-Thermal Systems and Machine Design Emphasis**

(42 semester hours)  
Engineering 305  
Engineering 319  
Engineering 322  
Engineering 324  
Engineering 328  
Engineering 333  
Engineering 334  
Engineering 382  
Engineering senior special topics interim  
Engineering elective  
Advanced mathematics/basic science elec-  
tive  
Advanced mathematics/basic science/engi-  
neering elective

Group majors combining Engineering and  
another discipline (but not accredited  
by ABET) may be appropriate for some  
students (see the chair for more infor-  
mation).

**ENGINEERING MINOR**

(Six approved engineering courses)

Engineering 106 or Chemistry 104

At least two from: Engineering 202, 204 or 209

At least two 300-level courses including one design courses from:

Chemical: Engineering 331 (Reactors) or 335 (Separations)

Civil & environmental: Engineering 308 (environmental), 321 (Hydraulics) or 327 (Structures)

Electrical & computer: Engineering 325 (Digital) or 332 (Analog)

Mechanical: Engineering 333 (Thermal/Fluids) or 322 (Machines)

The minor is not accredited by ABET.

**COURSES**

**101 Introduction to Engineering Design** (2). F An introduction to the engineering design process and resource design tools by means of projects, lectures, homework, mentor visits, and team meetings. Team projects, including service learning, require application of creativity, engineering analysis, and computational tools. Readings, lectures, and discussions also examine the areas of technology in society, engineering ethics, and library research methods. Various computer software tools are introduced and used. This course fulfills the foundations of information technology core category.

**106 Engineering Chemistry and Materials Science** (4). S. An introduction to the science of engineering materials. Engineering properties of materials - mechanical, electrical, and chemical - are closely linked to the underlying solid state and molecular structure. Chemistry relating to various aspects of design including phase change, solution theory, acid-base solutions, and chemical equilibrium is presented. This course is team-taught by chemists and engineers to facilitate the integration of basic chemical principles and engineering design. Issues of stewardship of resources are addressed. Laboratory. Prerequisites: Chemistry 103, Engineering 101, and Mathematics 170 or 171.

**181 Engineering Graphical Communication Lab** (2). F This laboratory course focuses on

techniques and computer software tools used for visualization and engineering communication. The course introduces graphical techniques for spatial analysis, including orthographic projection, free-hand sketching, pictorial representation, descriptive geometry, sections, basic dimensioning, and tolerancing.

**202 Statics and Dynamics** (4). F and S. A study of fundamental principles of mechanics and their application to the problems of engineering. Vector algebra, forces, moments, couples, friction, virtual work, kinematics of a particle, kinematics of a rigid body, dynamics of particles and rigid bodies, impulse, momentum, work, and energy are presented in two and three dimensions. Prerequisites: Physics 133, Mathematics 172.

**204 Circuits Analysis and Electronics** (4). S. An introduction to the theory and application of electronic circuits and devices. The following topics are covered: basic linear circuits (including frequency and transient response), semiconductor devices (diodes, op-amps, comparators, etc.), electric power, electric safety, and DC machines. Laboratory exercises are used to illustrate the material covered in the lecture portion of the course. Students will measure voltage, current, resistance, power, transient response, resonant circuits, voltage regulators, operational amplifiers. Students will investigate digital logic circuits. Co-requisite: Mathematics 231 Pre-requisite: Physics 235.

**209 Introduction to Conservation Laws and Thermodynamics** (4). F and S. This course introduces several foundational engineering topics. Included are single and multi-component process material and energy balances (conservation laws), the first and second laws of thermodynamics and heat transfer. Study of chemical kinetics and equilibrium demonstrates the link between science and design begun in Engineering 106 and also broadens the student's knowledge of chemistry. Issues of stewardship of materials and resources are addressed. Laboratory. Prerequisites: Engineering 106 and Mathematics 172 or permission of the instructor.

**220 Introduction to Computer Architecture** (4). F. A study of computer organization (including memory hierarchy, I/O, bus-based systems, distributed systems, and parallel

systems), and computer architecture (including CPU control, pipelining, and instruction set architecture). Laboratory exercises emphasize principles. Prerequisites: A programming language course, normally Computer Science 104 or 108 or permission of the instructor.

*Prerequisite to all courses numbered 300 or higher is formal admission to a BSE concentration.*

**302 Engineering Electromagnetics (4).** S. A study of the laws and engineering applications of electric and magnetic fields in various conductive, dielectric, and magnetic materials and under various boundary conditions. Emphasis is on the analysis and design aspects of transmission line circuits. Prerequisites: Mathematics 231 and Physics 235.

**303 Chemical Engineering Principles and Thermodynamics (3).** F. This course continues the study of chemical engineering principles begun in Engineering 209. Included are material and energy balances with reaction and introduction to vapor-liquid and liquid-liquid equilibrium including the concepts of dew and bubble points and the flash process. Process simulators (HYSYS) are introduced. Principles are reinforced with an in-depth team design project of a commercial process. Basic concepts of thermodynamics, i.e., equilibrium, reversibility, system are presented. The first and second laws are studied including the Carnot cycle and reversible process equipment as models of best performance. This material provides the foundation for the in-depth study of thermodynamics in Engineering 312. Prerequisites: Engineering 209, Mathematics 231, and concurrent registration in Chemistry 317.

**304 Fundamentals of Digital Systems (4).** S. An introduction to the fundamental principles of logic design in digital systems. Topics include: Boolean algebra, analysis and synthesis of combinational and sequential networks, register transfer language, micro-operational description and applications to computer design, computer organization and assembly language programming, and asynchronous logic. The student is introduced to digital logic families and programmable logic devices, digital logic CAD tools, logic synthesis and hardware description languages (VHDL). Lab-

oratory work will include logic design and assembly language programming. Prerequisites: Engineering 204 and a programming language course (normally Computer Science 104).

**305 Mechanics of Materials (4).** F. Application of principles of mechanics to the solution of problems in stress and strain of engineering materials, including resistance to force, bending, torque, shear, eccentric load, deflection of beams, buckling of columns, compounding of simple stresses, introduction to theory of failure, and energy methods. Prerequisites: Engineering 106 and 202.

**306 Principles of Environmental Engineering (4).** F. A study of environmental engineering and science principles relevant to engineered and natural systems. Topics considered in this course include an overview of the domains of environmental engineering; relevant units of measurement; population dynamics; contaminant types, sources and presence; chemical stoichiometry, equilibria, and kinetics; mass and energy balances; mass/particle transport processes; microbial ecosystem structure and function; biogeochemical cycling; and oxygen demand. Prerequisites: Engineering 209, or permission of the instructor.

**307 Electrical Signals and Systems (4).** F. Advanced techniques for the analysis of analog electrical systems. Topics include: frequency domain analysis, Laplace transforms, Fourier series, Fourier transforms, and continuous versus discrete signal analysis. Frequency response is analyzed using transfer functions, Bode plots, and spectral plots. Digital Signal Processing (DSP) is introduced. Prerequisites: Engineering 204, Mathematics 231.

**308 Environmental Engineering Design (4).** S. Application of environmental engineering and science principles to the design of environmental control measures and engineered systems. Problems considered in this course will include design of water supply and treatment processes; wastewater treatment processes; processes for air pollution control, groundwater remediation; and solid and hazardous waste management. Prerequisites: Engineering 306, or permission of the instructor.

**311 Electronic Devices and Circuits (4).** F. A study of the characteristics and qualitative internal action of commonly used micro-

electronic devices for discrete and integrated circuits, such as diodes, junction field-effect transistors (JFETs), metal-oxide semi-conductors FETs (MOSFETs), and bipolar junction transistors (BJTs). Application of these devices in basic amplifier circuits is explored. Laboratory exercises are used to illustrate concepts. Prerequisite: Engineering 204 and Mathematics 231.

**312 Chemical Engineering Thermodynamics (4).** S. Thermodynamic topics important in Chemical Engineering are addressed. The properties of real fluids and equations of state, properties of mixtures, phase equilibrium, and chemical equilibrium. Prerequisites: Engineering 303, and Chemistry 317.

**314 Vibration Analysis (4).** S. Analysis of mechanical vibration in both transient and steady state regimes, employing analytical and computer techniques for solution. Linear and non-linear problems are investigated with original inquiry suggested and encouraged. Prerequisites: Engineering 202 and Mathematics 231.

**315 Control Systems (4).** F. An introduction to linear feedback control theory, including transient and frequency response, stability, systems performance, control modes, and compensation methods. Hydraulic, electrical, pneumatic, and inertial components and systems are investigated and employed. Prerequisites: Engineering 204 and Mathematics 231.

**318 Soil Mechanics and Foundation Design (4).** S, alternate years. Soils studied as engineering materials whose behavior is dependent upon soil types, index properties, and soil moisture conditions. The scope of the course includes soil structures, index properties, soil classification, permeability, compressibility and consolidation, soil testing, soil stresses, and foundation design. Laboratory experiments are used to emphasize principles. Prerequisite: Engineering 305.

**319 Introduction to the Thermal/Fluid Sciences (4).** F. An introduction to the engineering thermal and fluid sciences including elements of thermodynamics, fluid mechanics, and heat transfer. Concepts include the properties of fluids, first and second laws of thermodynamics, external and internal viscous and ideal flows, and conduction, convection, and radiation heat transfer. Laboratory and project exercises are used to illustrate con-

cepts. Prerequisites: Engineering 202 and 209, Mathematics 231.

**320 Hydraulic Engineering (4).** S. Application of the basic principles of fluid mechanics to practical problems in hydraulic and hydrologic analysis. Topics include fluid statics, hydrology, open channel flow, closed conduit flow, and centrifugal pumps. Computer techniques and laboratory exercises are used to emphasize principles. Prerequisite: Engineering 319.

**321 Hydraulic Engineering Design (4).** F. Application of principles of hydraulics and hydrology to the design of hydraulic systems. Problems considered in this course will include design of pipe networks for water distribution, design of sewage collection systems, design of pumping facilities, design of groundwater remediation systems, and design of flood control structures. Computer techniques will be frequently employed. Prerequisite: Engineering 320.

**322 Machine Design (4).** S. Application of engineering mechanics, materials, and failure theories to the analysis and design of mechanical elements and systems. Computer techniques are used as aids to analysis and design. Prerequisite: Engineering 305.

**324 Materials and Processes in Manufacturing (4).** S. This course introduces students to the various mechanical and management issues involved in the fabrication of manufactured goods. Scientific and engineering principles are applied to fabricating processes such as casting, forming, and machining so as to determine the relation of process to material properties, economics, dimensional accuracy, and energy requirements. Topics such as computer-aided manufacturing (CAM), numerical control (NC), statistical quality control (SQC), and quality management are also explored. Field trips and laboratories are used to support the lecture material. Prerequisites: Engineering 106 and 305.

**325 Computer Architecture and Digital Systems Design (4).** F. Design of advanced digital systems using programmable logic, Application-Specific Integrated Circuits (ASICs), and microprocessors. Microprocessor architecture including pipelining, memory hierarchy, cache, instruction set architecture, CPU control, bus standards, I/O, supersca-

lar, and Very Long Instructive Word (VLIW) approaches. Interfacing and communication techniques, including data error detection and correction codes. Introduction to parallel processing. Laboratory exercises emphasize the design of microprocessor-based digital systems. Prerequisite: Engineering 304.

**326 Structural Analysis (4).** S. A study of beams, two-dimensional trusses, and rigid frames. Course work includes calculation of shear forces and bending moments due to fixed and moving loads, calculation of deflection, analysis of moving loads using influence lines, and the analysis of statically indeterminate structures. The course also includes an introduction to matrix methods in structural analysis. Prerequisite: Engineering 305.

**327 Structural Design (4).** F. Application of principles of mechanics of solids and structural analysis to the design of structural members made of steel or reinforced concrete. Load and factored resistance design procedures are studied along with the current steel specification for the design, fabrication, and erection of structural steel for buildings and the building code requirements for reinforced concrete. Computer techniques are used as aids to analysis and design. Prerequisite: Engineering 181, Engineering 326.

**328 Intermediate Thermal/Fluid Sciences and Design (4).** S. An intermediate treatment of heat transfer and thermodynamics including analysis and design related to steady and unsteady conduction with an emphasis on two and three dimensions, free and forced convection, radiation modes of heat transfer, power and refrigeration cycles, air conditioning processes, chemical equilibrium, and combustion. Laboratory, design, and computer exercises are utilized to emphasize principles. Prerequisite: Engineering 319.

**330 Fluid Flow and Heat Transfer (4).** S. Applications of fluid flow and heat transfer fundamentals to Chemical Engineering problems including heat exchanger design and designs for the transportation and metering of fluids. Unit operations of filtration and evaporation are covered. Prerequisites: Engineering 209 and 303.

**331 Kinetics/Reactor Design (4).** F. An introduction to chemical kinetics and reactor design. Principles of kinetics of homogeneous

and heterogeneous reactions with differential and integral analysis of kinetic data are included. Ideal reactor design concepts, non-isothermal reactor design, and design of catalyzed fluid-solid reactors are presented. Mass transfer, as it impacts multiphase reactor design, is introduced. One open-ended team design project and one kinetics lab project will be done to reinforce concepts presented in class. Prerequisites: Engineering 312, 330, and Chemistry 317.

**332 Analog Circuits and Systems Design (4).** S. Feedback principles and electronic circuit theory and device theory applied to multi-stage transistor amplifiers. Detailed study of operational amplifier specs, nonidealities, and compensation. Introduction to filter theory and practical realizations. Power supply design: Rectifier circuits, linear, and switching regulators. Nonlinear circuits: Comparators, multipliers, Schmitt trigger, S/H circuits, multivibrators, and oscillators. Introduction to noise analysis and low noise design. Emphasis on realization of designs using commercially available ICs. Design experience emphasized in projects and the laboratory. Prerequisites: Engineering 307 and 311.

**333 Thermal Systems Design (4).** F. Advanced heat transfer, thermodynamic, and fluid flow topics important for the design of thermal systems are presented. Availability (exergy) analysis and methods for the optimization of system components are given. Selection and design of fluid flow and heat transfer equipment used in energy conversion systems are emphasized. Economic evaluation is studied. A co-generation system is studied throughout the semester to emphasize basic principles of analysis and design. A project is required. Prerequisite: Engineering 328.

**334 Dynamics of Machinery (3).** S. This course investigates various dynamic aspects of machinery. An in-depth study is made of mechanisms such as the four-bar linkage. Cams and gears are studied in the context of their use in machines. Vibration concerns are addressed including methods of balancing rotating machinery. Kinematics and kinetics are studied in a three-dimensional space with an emphasis on application in the area of robotics. Computer simulation of mechanisms is used to reinforce basic concepts. Prerequisite: Engineering 202.

**335 Mass Transfer and Staging Operations** (4). F Mass transport fundamentals are applied to Chemical Engineering design problems. Principles of equilibrium mass transport operations are applied to distillation, gas absorption, extraction, and humidification design. Prerequisite: Engineering 312 and 330.

**337 Chemical Engineering Laboratory** (2). S. Principles of fluid flow, heat transfer, mass transfer, stage-operations, and chemical kinetics are studied using small-scale equipment. Evaluation and analysis of experimental observations, project proposals, and report writing is emphasized. Prerequisites: Engineering 331, 335, and Chemistry 317.

**338 Introduction to Traffic Engineering and Highway Design** (4). S, alternate years. Introduction to the basic concepts of traffic engineering and highway design. The traffic-engineering portion introduces basic concepts including how the motorist, vehicle, road, and pedestrian interact, roadway capacity and Level-of-Service, traffic flow and queue theory, and traffic signal timing. Software applications are introduced regarding traffic simulation and capacity analysis. The highway design portion of the course focuses on the basics of horizontal and vertical alignment of roadways, design vehicle, design speed, superelevation, sight distance, and other design considerations. Prerequisite: admission to engineering program or permission of the instructor.

**339 Senior Design Project** (2). F This is the first course in the senior design project sequence. Emphasis is placed on design team formation, project identification, and production of a feasibility study. Students focus on the development of task specifications in light of the norms for design and preliminary validation of the design by means of basic analysis and appropriate prototyping. Lectures focus on integration of the design process with a reformed Christian worldview, team building, and state-of-the-art technical aspects of design. Interdisciplinary projects are encouraged. Prerequisites: Concurrent registration in the seventh semester of the model program for a particular concentration or permission of the instructors; developing a Christian mind and philosophical foundations.

**340 Senior Design Project** (4). S. This is the second course in the senior design project

sequence. Emphasis is placed on the completion of a major design project initiated in Engineering 339. This project should entail task specifications in light of the norms for design by means of engineering analysis and an appropriate prototype focused on primary functionality. A final presentation is given at the May senior design project program. Lectures continue to focus on integration of the design process with a reformed Christian worldview, team activity, and state-of-the-art technical aspects of design. Prerequisites: Engineering 339 (taken the semester immediately prior). This course fulfills the integrative studies core category.

**342 Process Dynamics, Modeling, and Control** (4). S. Introduction to the analysis of process dynamics, and to the design and analysis of process control systems. Covers transient and frequency response, transfer functions, stability, performance, linearization, decoupling, and multivariable control. Prerequisites: Engineering 209 and Mathematics 231.

**382 Engineering Instrumentation Laboratory** (1). S. Laboratory course, which serves as an introduction to the characteristics and uses of transducers to measure displacement, strain, pressure, temperature, velocity, acceleration, and other physical quantities. Emphasis is on the usefulness, accuracy, and reliability of measurement systems in actual applications. Electronic signal conditioning techniques are covered. A design project using LabVIEW software and FilePoint data acquisition hardware is required. Written reports required. Prerequisites: Engineering 204.

**390 Independent Study**. F, I, and S. Independent readings and research. Prerequisite: permission of the chair.

### On Campus Interims

**W81 Advanced Computer Architecture with VHDL**. This course explores advanced computer architecture techniques including superscalar machines, Very Long Instruction Word (VLIW) scheduling, Explicitly Parallel Instruction Computing (EPIC) architectures, predicated execution, interrupts in a pipelined machine, and compiler optimizations for specific hardware platforms. Hardware designs are examined through the use of VHDL

(VHSIC [Very High Speed Integrated Circuit] Hardware Description Language). The course examines the VHDL design methodology and compares the behavioral, dataflow, and structural architecture description styles. Syntax constructs for describing sequential and concurrent modules are studied in detail. Verification techniques are also covered. Students design a variety of circuits and modules using sophisticated CAD tools, implement microprocessor subsystems and microprocessor interface circuits in the lab, and demonstrate their understanding of VHDL design principles. Prerequisite: Engineering 325 or permission of the instructor.

**W82 Finite-Element Analysis.** The finite-element method is a design and analysis tool widely used in many areas of engineering. In this course students consider the historical development, the fundamental principles, and the various applications of this method in the areas of structural mechanics and heat transfer. Exercises are assigned to orient the student to available general-purpose software. There is an in-depth focus on several design projects. Prerequisite: Engineering 305 or permission of the instructor.

**W83 Water and Wastewater Treatment Design.** This course addresses the application and theory of chemical, physical, and biological processes related to potable water treatment and wastewater treatment systems. Problems considered include unit process design for the following potable water treatment plant components: screening, coagulation, mixing, flocculation, chemical softening, filtration, disinfection, ion exchange, adsorption, membrane filtration, and residuals handling. Additional coverage includes unit process design for wastewater treatment components including: activated sludge, trickling filters, membrane bioreactors, aeration, clarification, and solids handling and stabilization. Prerequisites: Engineering 306 and senior standing or permission of the instructor.

**W84 Advanced Topics in Chemical Engineering Design.** This course addresses essential advanced topics that build on the foundational concepts from several earlier chemical engineering courses. Design topics covered include: mass transfer and staging operations, radiation heat transfer, nonelementary kinetics, corrosion, and materials of construction.

In addition, fundamental concepts of environmental, health, and safety issues for design are presented. Prerequisites: Engineering 330, 331, 335, and senior standing.

**W85 Stormwater Management.** Civil engineers today are frequently faced with the problem of managing the impact of stormwater within the urban environment. Management involves addressing issues of both stormwater quantity as well as quality. There are three specific goals for this course. The first goal is to introduce the basic principles and computational methods associated with stormwater flows, collection, storage, and treatment. The second goal is to understand basic stormwater management approaches used in practice today. The third goal is to learn how to use numerical modeling software to solve stormwater management design problems. Guest speakers, field trips, and case study reviews are also used to emphasize basic principles and management techniques. Prerequisite: Engineering 320 or permission of instructor.

**W86 Introduction to Power Systems.** This course is intended to serve as an introduction to electric energy systems and its basic operation principles. Students will be learn about the theory and methods related to AC power system analysis and design. Major components are to develop familiarity with power system engineering components, equipment and analytical tools; to understand and study of the largest machine ever built-the integrated power grid; to understand the use of transmission grids as a means of transport/delivery of energy; to use tools for the analysis of power systems (MATLAB/Simulink, PowerWorld, EasyPower, PSCAD/EMTP); to investigate flow of power on a power grid; to understand voltage regulation, real and reactive power, three phase power, power quality, efficiency, practical stability limits, etc.; and finally to become familiar with management and environmental issues associated with transmission grids / power systems. Prerequisite: Engineering 204 and senior standing or permission of the instructor.

**W88 Masonry Design.** In this course the student will become familiar with basic masonry materials, including clay brick, concrete block, mortar, grout and reinforcing accessories. The student will be able to analyze and

design unreinforced masonry structures using engineering methods. The student will understand the behavior of reinforced masonry structures and be able to design for flexure, shear, axial forces, combined flexure and axial forces, and in-plane shear forces. Problem sets and a final design-project report are required. Prerequisite: Engineering 326 or permission from instructor. Mr. L. De Rooy

### Off Campus Interims

**Business and Engineering for the International Market.** This course introduces the student to the nuances of business practices and product development in the international market, focusing on business, research, and development in Europe. Students learn how the languages, history, culture, economics, regulations, and politics of Europe shape the business and design process through tours of businesses, engineering-research facilities (industrial and academic), and manufacturing facilities as well as discussion sessions with leading business executives and research engineers in Europe. Locales include Amsterdam, Rotterdam, Delft, Brugge, Brussels, Paris, Koblenz, Offenbach, Zurich, Munich, Nürnberg, Leipzig, Berlin, Bremen, and Koln. Additional religious and cultural locales include The Begijnhof, The Hague, Louvain, Versailles, Notre Dame Cathedral, Reims, Heidelberg, Dachau, Neuschwanstein, Prague, St. Vitus Cathedral, Wittenberg, Magdeberg, and Koln Cathedral. Students keep a daily journal and complete study assignments that focus attention on key issues related to the day's tour. Prerequisite: Business 160 or Engineering 101 or permission of the instructor. E. Nielsen.

**Dutch Landscapes: Society, Technology, and Environment.** Few countries exist where human activities have exerted a greater influence in the shaping of the land than the Netherlands. With daily field excursions and detailed topographic maps, students study this country's richly varied and historically layered cultural landscapes. Land reclamation, water management, and environmental preservation technologies used over many centuries are an important part of understanding the complex interrelationships between society, technology, and land. Additionally, students have opportunities for direct engagement with people from this

country. Briefings, interpretation en route, topographic maps, and study-sheet assignments guide each field trip. Students spend one Sunday with a Dutch family. Open days are integrated to provide opportunities for personal travel. R. Hoeksema. Not offered interim 2010.

### The South African Miracle: Challenges and Accomplishments in Politics and Industry.

This course introduces students to a country with a tragic past but also a promising future. The primary academic objective is to gain firsthand knowledge and understanding of how racial injustice has been encountered in political and industrial contexts. Participants read and study South African history, culture, and industrial change as well as experience South African townships, meet with political leaders from a variety of political parties, and visit gold mines. Students explore South Africa's apartheid past, the struggles for and painful miracle of its democratic transition and the political-economy of the mining industry where interaction of politics, business, and race are poignant. Specific on-site visits include Robben Island, Soweto mining hostels, the University of Cape Town, the Apartheid Museum, and much more. M. Heun. Not offered interim 2010.

**Transforming Cambodia.** The goal of this class is to identify and experience the root causes of abject poverty in Cambodia. Issues to be engaged include food production capacity, land use trends, availability of adequate water or reasonable quality, availability of education and human health. This course plans to engage a variety of non-governmental organizations involved in supporting the holistic transformation of communities; CRWRC village projects enabling people to produce greater quantities of healthier food, water filtration and pumping methods, orphanages, Kindergarten classes, a hospital, and several evangelical churches, and the launch of a new Christian university (AIU). Students will contribute service-learning hours in these venues. Additionally, students will engage the cultural underpinnings of the current situation in Cambodia. A visit of the Angkor Wat temples will lay a ancient historical foundation of Cambodian culture, followed by the Killing Fields and Tuol Sleng prison to assess the recent impact of

the Khmer Rouge. Students will gain a clear understanding of what current living conditions are in Cambodia, how they have come to be as they are, what the impediments to change are, what can and is being done to make a positive and sustainable change to the average Cambodian citizen, or in other words, how to be agents of redemption in a deeply troubled society. This class is a cooperative learning adventure with Calvin College and Handong Global University (South Korea). Student evaluation will be based on participation with local culture, group discussion, individual journaling, and in a final report describing key features of their learning experience. D. Dornbos Jr., L. De Rooy, and A. Kim (Handong Global University).

**Business and Engineering in China.** China's emerging economy has a large impact on today's world, especially in business and engineering. During this interim students will spend three weeks in China meeting with business and engineering professionals who are part of this reshaping of the global economy. The course will include the major cultural and economic centers of China, starting in Beijing, continuing in Shanghai and surrounding areas, then Xiamen, and finally Guangzhou and Hong Kong. Approximately ten meetings will be arranged with business and engineering professionals. In addition many important historic and cultural sites will be explored, including the Chinese new year celebration. Evaluation is based on a journal and a reflective essay. Preference will be given to students majoring in the Business department or Engineering department. A. Si, L. VanDrunen.

### Seminars/Internships

**185/285/385 Engineering Internship (0).** Students who complete an Engineering Internship during the summer as part of the department's internship program, may receive transcript recognition for their effort. Freshmen, sophomores, and juniors will receive credit for Engineering 185, 285, and 385 respectively. These internships, consisting of engineering work at an appropriate level, should be for a minimum of nine (9),

full-time, consecutive weeks. Students must provide a brief written report of their activities under the signature of their supervisor. The students must also make a presentation of their internship work during the following semester. The report and copies of the presentation material should be submitted to the department's internship coordinator for approval. Other procedures and activities may be given internship credit. Application for exceptional cases must be made to the internship coordinator.

**294/394 Engineering Seminar (0).** F and S. A seminar devoted to an exploration of topics in engineering. Seminars will cover areas such as the practice of engineering design, non-technical issues in engineering practice, engineering graduate studies, and aspects of engineering analysis. Students will receive transcript recognition for Engineering 294 if they attend eight (8) seminars before being admitted to a BSE concentration and will receive transcript recognition for Engineering 394 if they attend eight (8) seminars after being admitted to a BSE concentration. Plant tours and technical society meetings may be substituted for seminars upon approval.

**387 International Engineering Internship (0).** Students, who complete an International Engineering Internship during the summer as part of the department's internship program, may receive transcript recognition for their effort. These internships, consisting of engineering work at an appropriate level, should be for a minimum of nine (9), full-time, consecutive weeks and shall take place in a country other than the United States and Canada. Students must provide a brief written report of their activities under the signature of their supervisor. The students must also make some type of presentation of their internship work during the following semester. The report and copies of the presentation material should be submitted to the internship coordinator for approval. Other procedures and activities may be given international internship credit. Application for exceptional cases must be made to the internship coordinator.

# English

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Professors \*R. Anker, S. Felch, D. Hettinga, K. Saupe, G. Schmidt, J.H. Timmerman,  
W. Vande Kopple (co-chair), J. Vanden Bosch, D. Ward\*\*  
Associate Professors J. Holberg, B. Ingraffia, D. Rienstra, E. Vander Lei (co-chair)  
Assistant Professors C. Engbers, G. Fondse, N. Hull, M. Marie, M. Campbell, L. Klatt,  
L. Naranjo-Huebl, D. Urban, J. Williams, J. Zwart  
Instructor A. Kortenhoven  
Adjunct M. Admiraal

The department offers a major and minor in English, majors and minors in secondary and elementary English education, a minor in writing, and interdisciplinary minors in ESL, in linguistics, and in journalism. A student may alter any of the recommended programs with the permission of an academic advisor. All professors in the department advise for the general major and minor. The advisors for the secondary-education programs are K. Saupe, W. Vande Kopple, and J. Vanden Bosch. The advisors for the elementary-education programs are D. Hettinga, N. Hull, and G. Schmidt. The advisor for the linguistics minor is W. Vande Kopple. The advisor for the journalism minor is D. Hettinga. The advisor for the ESL minor is E. Vander Lei. The advisors for the writing minor are C. Engbers, D. Hettinga, L. Klatt, J. Netland, G. Schmidt, and E. Vander Lei.

Students who plan to graduate with honors in English must complete a minimum of six honors courses (or 18 hours of honors work): at least three in the English department (not including Honors English 101) and at least two from the general curriculum. Honors English 101 may count as the sixth honors course required for graduation. Honors students must also complete English 399: "Honors Thesis", as one of their three honors courses in English. In addition to maintaining a cumulative GPA of 3.5 or higher, both within the major and overall, students must also earn at least a B+ on their Honors Thesis in order to graduate with honors. For specific questions about Honors requirements in the English department, contact the chair of the English department's curriculum committee.

A minimum grade of C (2.0) in English 101 or 102 is required both for graduation and as a prerequisite to any concentration in the English department. Normally, English 101 is the first course taken in the department. The core requirement in written rhetoric is met by English 101, 100/102, or by examination. The literature core requirement is met by English 205, 210, 211, 215, 216, 217, 218, 219, 283, 285, 290, and 295.

## ENGLISH MAJOR

English 210 or 211  
English 215\*, 302, 304, 305, or 307  
English 216\*, 308, 309, 314, or 321  
(\*English 215 or 216 may be taken, but not both)  
English 334, 337, 339, or 370  
English 345, 346, 347, or 350  
English 217\* or 310  
English 218\*, 311, 312, or 315  
(\*English 217 or 218 may be taken, but not both)  
English 395  
Four English electives  
The four English electives include any English department course with the exception of English 101 or 100/102, 356, 357, and 359. Only one interim course may count towards the major.

## ENGLISH MINOR

English 210 or 211  
English 215, 216, 302, 304, 305, 307, 308, 309, 314, or 321  
English 217, 218, 310, 311, 312, or 315  
English 334, 337, 339, 345, 346, 347, 350, or 370  
Three English electives  
The three English electives include any English department course with the exception of English 101 or 100/102, 356, 357, and 359. Of the seven courses in the minor, at least two must be 300-level courses in language or literature. Only one interim course may count toward the minor.

## **WRITING MINOR**

English 275

English 301 or 355

English 201, 245, 262, 265, 380, or Communication Arts and Sciences/English 248

A literature course chosen in consultation with a program advisor

Two English electives from English 201, 245, 262, 265, 301, 355, 380, or Communication Arts and Sciences/English 248 chosen in consultation with a program advisor

One elective chosen in consultation with a program advisor

## **INTERDISCIPLINARY MINOR IN LINGUISTICS**

English 334

English 337

Communication Arts and Sciences 140

Communication Arts and Sciences 216

Three electives chosen in consultation with the program advisor

## **SECONDARY EDUCATION MAJOR IN ENGLISH**

English 210 or 211

English 215

English 216

English 217

English 218

English 283, 312, 320, 321, or 322

English 326

English 334, 335, or 337

English 338 or 339

English 346

English 357

### **Cognate**

Communication Arts and Sciences 230

Ideally, students should take English 357 in the semester immediately preceding their student-teaching semester. Students must complete English 357 successfully before they may student teach.

For their student-teaching semester, students must register for both Education 346 and English 359.

Before being considered for a student-teaching placement, students must pass (80% or

better on each section) all five sections of the English department screening exam. They must pass all five sections of the exam by December 1 of the calendar year immediately prior to their student-teaching semester. To take this exam, students must make an appointment with the English department administrative assistant. Students have four chances to take the exam per calendar year, and they must allow at least two weeks to elapse between the time they try the exam once and the time they try it again.

Additional criteria for approval for student teaching are found in the *Teacher Education Program Guidebook*, available in the Education department.

## **SECONDARY EDUCATION MINOR IN ENGLISH**

English 210 or 211

English 215 or 216

English 217 or 218

English 283, 312, 320, 321, or 322

English 334, 337, or 339

English 346

English 357

All those who elect the secondary education minor in English in academic year 2007-2008 and later must pass (80% or better on each section) all five sections of the English department screening exam. They must pass this exam before they can be certified in the minor. They must pass all five sections of the exam by December 1 of the calendar year immediately prior to their student-teaching semester. To take the exam, students must make an appointment with the English department administrative assistant. Students have four chances to take the exam per calendar year, and they must allow at least two weeks to elapse between the time they try the exam once and the time they try it again.

## **ELEMENTARY EDUCATION MAJOR IN ENGLISH**

English 210 or 211

English 215, 216, or 346

English 217 or 218

English 325

English 326 or 328

English 334, 337, or 339

English 283, 312, 320, 321, or 322  
 English 356  
 One English elective

### **Cognate**

Communication Arts and Sciences 230

### **ELEMENTARY EDUCATION MINOR IN ENGLISH**

English 210 or 211  
 English 215 or 216 or 346  
 English 217 or 218  
 English 325 or 326  
 English 283, 312, 320, 321, or 322  
 English 356  
 One English elective

### **ELEMENTARY EDUCATION LANGUAGE ARTS GROUP MAJOR**

English 210 or 211  
 English 215, 216, or 346  
 English 217 or 218  
 English 283, 312, 320, 321, or 322  
 English 325  
 English 326 or 328  
 English 356  
 Communication Arts and Sciences 203 or  
 215  
 Communication Arts and Sciences 214  
 Communication Arts and Sciences 230  
 Two English or Communication Arts and  
 Sciences electives

### **ELEMENTARY EDUCATION LANGUAGE ARTS GROUP MINOR**

English 210 or 211  
 English 215, 216, or 346  
 English 217 or 218  
 English 325 or 326  
 English 356  
 Communication Arts and Sciences 203 or  
 215  
 Communication Arts and Sciences 214  
 One English or Communication Arts and  
 Sciences elective

### **ENGLISH AS A SECOND LANGUAGE: ENDORSEMENT FOR ELEMENTARY OR SECONDARY EDUCATION**

Communication Arts and Sciences 216  
 English 334 or Spanish 340  
 English 335  
 English 338

Interdisciplinary 356 or 357  
 Interdisciplinary 301/302 (concurrent with  
 Education 302-303)  
 Education 303 (concurrent with Education  
 302 and Interdisciplinary 301/302)

Note that the ESL minor must be combined with a major concentration, even for elementary education.

### **ENGLISH AS A SECOND LANGUAGE: NON-EDUCATION MINOR**

Communication Arts and Sciences 216  
 English 334  
 English 335  
 English 338  
 Interdisciplinary 301 or 302  
 Sociology 253  
 An approved elective

\*Program advisors are K. Miller (Spanish)  
 and E. Vander Lei (English).

### **INTERDISCIPLINARY MINOR IN JOURNALISM**

Communication Arts and Sciences 230  
 English 245  
 English 265  
 Three electives chosen in consultation with  
 the program advisor  
 English 380 or Communication Arts and  
 Sciences 346

### **COURSES**

*For clarification of even and odd years, see  
 English Department Web site.*

100 **Enhanced Written Rhetoric I** (3) F. English 100 is the first part of a year-long enhanced course sequence in written rhetoric. See the complete sequence description under English 102. Enrollment in English 100/102 is by special arrangement with student academic services and the English department.

101 **Written Rhetoric** (3). F and S. In this course, students write several expository essays in which they practice rhetorical strategies, research-based argumentation, and methods of composing effective prose. In the process of writing these essays, students consider language as a means of discovering truth about God, the world, and themselves, and they explore its potential to communicate truth and, thereby, to transform culture.

**102 Enhanced Written Rhetoric II (3)** S. In this year-long, enhanced course sequence in Written Rhetoric, students write expository essays, practicing methods of composing effective prose, applying various rhetorical strategies, learning how to conduct academic research, producing research-based argumentation, and developing grammatical and syntactic proficiency in the context of their own prose. In the process of writing these essays and mastering conventions of language, students consider language as a means of discovering truth about God, the world, and themselves; and they explore its potential to communicate truth and, thereby, to transform culture. Prerequisite: English 100.

**201 Academic and Professional Writing (3)** S (odd years). A second course in rhetoric and composition, designed for students who wish advanced study of academic writing practices. Includes reading, a consideration of the principles of written rhetoric, and extensive practice in writing short papers in a variety of academic traditions.

**205 Understanding Literature (3)** F and S. This course involves a study of selected literary works with an emphasis on the fundamental elements of literature and methods of reading. Discussion topics include the genres of literature and their conventions, the tools authors use to create meaning and effect, the ways readers can interpret and respond to texts, and the roles of imaginative literature in shaping and reflecting culture. An abiding concern will be how Christians might take a distinctive approach to this area of human culture.

**210 World Literature I (3)** F and S. This is a course of selected readings and lectures in the literature of the world from the ancient world through the Renaissance, with emphasis on the Western tradition. Additional attention will be given to the literatures of non-Western cultures, such as those of Asia, Latin America, and Africa.

**211 World Literature II (3)** F and S. This is a course of selected readings and lectures in the literature of the world from the Enlightenment to the present, with emphasis on the Western tradition. Additional attention is given to the literature of non-Western cultures, such as those of Asia, Latin America, and Africa.

**215 Survey of British Literature I (3)** F and S. This course surveys major works of British literature from its beginnings to the late eighteenth century.

**216 Survey of British Literature II (3)** F and S. This course surveys major works of British literature from the late eighteenth century into the twentieth century.

**217 Survey of American Literature I (3)** F and S. This course is a chronological study of representative works of the American literary landscape with special attention to various movements from Colonial literature through Realism. The course examines the difficult questions and struggles of human experience as they have been expressed in numerous literary genres from the very beginnings of American cultural history.

**218 Survey of American Literature II (3)** F and S. This is a chronological study of representative works of American literature with special attention paid to various movements from late Realism to the present. Students reflect upon contemporary cultural issues through this survey of historical and artistic works.

**219 Survey of Canadian Literature (3)** This course is a survey of major works of Canadian literature from the nineteenth and twentieth century. Readings include fiction, poetry, and drama, with an emphasis on English Canadian writers. Some attention is given to French Canadian and native Canadian writers in translation. Not offered 2009-2010.

**245 Basic Journalism (3)** F A study of the principles and techniques of journalism—especially newspaper journalism—specifically, the definition of news and the varying policies governing the selection and presentation of local, national, and international stories. Against the background of a critical appraisal of current practices, students write, edit, and evaluate news reports and feature stories.

**248 Writing for the Media (3)** F An introduction to the content, styles, and formats of media scripts. The course emphasizes the differences in media writing compared with more familiar forms of writing, the role of the script as text in producing media programs, the styles of writing used (journalistic, dramatic, polemical, and emotive), and

the technical requirements for scripts used to focus the work of directors, actors, camera, and sound technicians, editors, and mixers in creating a media product. Also listed as Communication arts and sciences 248. Prerequisite: English 101 or 102.

**262 Business Writing (3).** F, S and I. A course introducing students to the kinds of writing and computer presentations that are required in business-related fields. Students collect examples of and practice composing the types of professional communication that they are likely to craft on the job. The class is conducted as a workshop; students consult with each other and with the instructor. Each student submits several projects. The class also includes a group report (with written, multi-media, and oral portions), in-class writing and computer exercises, and the use of word-processing and presentation software. Prerequisite: completion of English 101 or 102 with a grade of C+ or above.

**265 Feature Journalism (3).** S (even years). A course in the art of writing feature stories. The course pays particular attention to the process by which specialized information from various fields—government, science, engineering, medicine, law, religion, and business—is prepared for public comprehension. English 245 is recommended but not required as a prerequisite.

**275 The Craft of Writing (3).** F A course in the foundational principles and practices of writing. Students compose in a variety of written genres, exploring composition from two perspectives—how texts are constructed and what they accomplish. From these two perspectives, students will consider the two classical categories of written genres: poetics (the study of belletristic writing) and rhetoric (the study of persuasive writing). This is a foundational course for students who are interested in advanced study of writing. Prerequisite: English 101 or 102 or approval of the instructor.

**283 African-American Literature (3).** F and S. A chronological survey of major writers and works of African-American literature. Readings will include fiction, poetry, and drama, with special attention paid to historical and cultural contexts.

**285 Russian Literature (3).** S. A study of major Russian writers of the nineteenth and

twentieth centuries. Authors to be read include, but are not limited to, Gogol, Turgenyev, Dostoevsky, Tolstoy, Bulgakov, Akhmatova, and Solzhenitsyn. Special attention will be paid to spiritual and moral issues, which are of central importance in the Russian literary tradition.

**290 Literature and Women (3).** F Readings will emphasize poems, stories, plays, essays, and literary criticism written by women; these readings will include both the established (e.g., Jane Austen, Emily Dickinson, Edith Wharton, and Charlotte Bronte) and the recovered (e.g., Anne Lock, Aphra Behn, Charlotte Smith, and Zora Neale Hurston). In addition to focusing on the many contributions made by women to literary culture, this course will examine male and female representations of the feminine experience as well as the issue of gender and its implication for literature.

**295 Special Topics in Literature (3).** F and S. Fall – Asian American Literature. The course will consider Asian American literature within historical and cultural contexts of the American literary tradition, including form and genre. It will investigate representations of Asian American experience and their intersection with dynamics of faith, ethnicity, class, nationalism, and gender in American culture. Spring – Graphic Novel. Students will read a number of current and “canonical” graphic novels and comics, with reference to the cultural and historical frame in which each work rests. The course will examine in particular the ways in which graphic novels and comics complicate traditional understanding of genre and narrative.

**296 Film as a Narrative Art (3).** F (odd years). In-depth examination of the art of narrative film, focusing each semester on one or more directors, genres, or styles of filmmaking. The course pays particular attention to narration and narrative structure, characterization, conflict, setting, and point of view and also acquaints students with literary adaptation and with the contribution of film image and sound to narrative development. The course emphasizes the development of student skills in writing about film. Also listed as Communication Arts and Sciences 296.

**301 Creative Non-fiction (3).** S. A course in the principles and practice of creative non-fiction. Students will examine a variety of models and engage in extensive practice in the genre. Special emphasis will be given to the relationship of faith and art for the writer. Prerequisite: English 101 or 102.

**302 British Literature of the Middle Ages (3).** F (even years). This course examines the ways in which the literatures of the Anglo-Saxon and Middle English periods both reflect and impact the culture out of which they emerge. In studying an age in which art, philosophy, history, architecture, bookmaking, and social and language issues converge in the literature in strikingly uniform ways, students will understand the engagement of many cultural forces and the effect of that engagement upon a culture's expression.

**304 British Literature of the Sixteenth Century (3).** S (odd years). A study of the poetry and of some prose of the sixteenth century and of the drama of the sixteenth and early seventeenth centuries.

**305 British Literature of the Seventeenth Century (3).** F (odd years). A study of poetry and prose in England from 1600 to 1660 with emphasis on the religious lyric, especially the poetry of Donne and Herbert.

**307 British Literature of the Eighteenth Century (3).** S. A study of writing and its cultural contexts, with detailed attention to the works of Dryden, Swift, Addison, Pope, Johnson, and Boswell. Not offered 2009-2010.

**308 British Literature of the Early Nineteenth Century (3).** F (even years). A study of the Romantic writers of England in both poetry and prose, with intensive study of Blake, Wordsworth, Coleridge, Byron, Shelley, and Keats.

**309 British Literature of the Middle and Later Nineteenth Century (3).** S (odd years). A study of the Victorian writers of England in both poetry and prose, including intensive study of Tennyson, the Brownings, and Arnold among the poets and Newman, Carlyle, Huxley, and Ruskin among the prose writers.

**310 Literature of the United States I: Settlement to Civil War (3).** F A close examination of the fiction, poetry, and non-fiction

prose of the United States prior to the Civil War. Special attention is given to major figures and cultural issues within the diverse literary landscape of America. Representative writers include Bradstreet, Hawthorne, Melville, Emerson, Thoreau, and Whitman.

**311 Literature of the United States II: Civil War to the Great Depression (3).** S. A close examination of the fiction, poetry, and non-fiction prose of the United States from the Civil War to the Great Depression. Special attention is given to selected figures and cultural issues within the diverse literary landscape of America. Representative writers include Dickinson, Twain, Howells, James, Wharton, Cather, Fitzgerald, Robinson, Frost, and Eliot.

**312 Literature of the United States III: World War II to the Present (3).** S. A close examination of the fiction, poetry, and non-fiction prose of the United States from World War II to the present. Special attention is given to selected figures and cultural issues within the diverse literary landscape of America. Representative writers include Faulkner, O'Connor, Welty, Ellison, Roethke, Bellow, Baldwin, and Updike.

**314 The British Novel (3).** F (even years). A study of the British novel from its origins through its proliferation of experimental forms in the early twentieth century. This course emphasizes the art and thought of the major novelists, the growth of major strains such as epic, romantic, realistic, and symbolic fiction, and the history of ideas that influenced the growth of novelistic fiction. Not offered 2009-2010.

**315 The American Novel (3).** F (odd years). A chronological study of the major novels of the American literary tradition, with reference to the historical and cultural frame in which each work rests.

**318 Non-Western Literature: Africa or South Asia (3).** S. A historical survey of significant works of literature from a non-Western region of the world. The focus of the course will alternate between the literature of Africa and South Asia.

**320 Modern British and American Poetry (3).** F (even years). Intensive reading of selected works of major twentieth-century British and American poets.

**321 British and Commonwealth Literature of the Twentieth Century (3).** S (even years). The readings include fiction, poetry, drama, and non-fiction prose of twentieth-century British literature. Special attention is given to the emergence of high Modernism in the 1920's and 1930's, as well as its eventual permutation into Post-Modernism and to the effects of the two World Wars and the demise of the British Empire on the development of the literary tradition. Selected writers include James Joyce, Virginia Woolf, T.S. Eliot, W.B. Yeats, Dylan Thomas, George Orwell, Doris Lessing, Graham Greene, V.S. Naipaul, and Derek Walcott.

**322 Modern Drama (3).** F (even years). A study of major British, American, and Continental playwrights of the twentieth century. Playwrights to be read may include, but are not limited to, Ibsen, Chekhov, Shaw, Pirandello, Brecht, Williams, Miller, O'Neill, Beckett, Pinter, Shaffer, Fugard, and Norman. Emphasis is placed on the significant movements in modern drama and questions of gender-based criticism.

**325 Children's Literature (3).** F and S. A study of children's literature, including intensive reading of the best of this literature and the application of literary standards to what is read.

**326 Adolescent Literature (3).** F. A study and critical evaluation of the nature and content of adolescent literature, including intensive reading, application of literary standards, and discussion of issues in the field of young adult literature: censorship, selection criteria, reader-response theories, ethnicity, and gender-based criticism.

**328 Recent Literature for Children (3).** S (odd years). A survey and evaluation of children's and young adult literature, with emphasis on the more recent literature; consideration of criteria for selecting such literature in the classroom; examination of reference tools; recent and historical trends; issues and approaches to understanding children's and young adult literature; and study of several representative works. Prerequisite: English 325 or 326.

**334 Linguistics (3).** F and S. A study of some of the more interesting and important characteristics of language, with particular atten-

tion given to the processes of language acquisition; to patterns and effects of linguistic change through time; to variations in language from region to region, social class to social class, and gender to gender; and to the assumptions informing the nomenclature, methodology, and scope of traditional, structural, transformational, generative-semantic, and text grammars. The course incidentally considers the relationship of these grammars to the study of reading and composition.

**335 Sociolinguistics and Issues in Language Education (3).** F. This course involves two major activities: (1) an examination of selected topics that have arisen in recent sociolinguistic research, particularly those topics centering on questions about how standard and nonstandard languages and dialects appear to affect people's educational success; and (2) an evaluation of how these topics should affect approaches to language education, particularly approaches to teaching English as a Second Language (ESL). Prerequisite: English 101 or 102.

**337 History of the English Language (3).** S. An analysis of the changes that have occurred throughout the history of the English language, based on an intensive study of selected portions of the *Oxford English Dictionary* and passages from Chaucer, Shakespeare, and various English translations of the Bible.

**338 Grammar for Teachers of ESL (3).** F. In this course, students will review the fundamentals of English grammar, learn of the possibilities and limitations of teaching grammar in the ESL classroom, and research or practice the teaching of some of this grammatical material, so that they can make the most of that part of the ESL curriculum typically dedicated to the teaching of grammar. Prerequisite: English 101 or 102.

**339 English Grammar (3).** I. A study of traditional grammar, focusing on its history, its system, its applications, its competitors, and its place in the middle school and high school classroom; special emphasis will be given to the system and terminology of this grammar.

**345 Chaucer (3).** S (even years). A study of Chaucer's *Canterbury Tales* and selections from his minor work, which reflect his handling of

the major cultural and religious events and issues of his time. Supplementary study of other works and literary movements related to the period are included.

**346 Shakespeare (3).** F and S. A study of the major works of William Shakespeare.

**347 Milton (3).** S (odd years). A study of the poetry and prose of John Milton.

**355 Creative Writing (3).** F and S. A course in the principles and practice of fiction or poetry, with the emphasis to be announced prior to registration each time the course is offered. Students will examine a variety of models and engage in extensive practice. Special emphasis will be given to the relationship of faith and art for the writer. Students may take both the fiction and the poetry version of the course for credit. Offered as poetry writing in Fall and as fiction writing in Spring.

**356 Language, Grammar, and Writing for the Elementary Classroom (3).** F. An introduction to several significant and practical aspects of the nature of language, a review of the nature of traditional grammar, including some comparisons of traditional grammar with more recently developed grammars, and an exploration of the relationships between these grammars and composition instruction and practice.

**357 Teaching of Writing (3).** F. A course in the principles, practice, and pedagogy of composition, especially as these apply to middle and high school writing programs. Extensive reading and frequent exercises in composition, revision, and evaluation. Majors in secondary education programs must take this course in the fall semester of their final year.

**359 Seminar in Principles of and Practices in Secondary Education (3).** S. A course in perspectives on, principles of, and practices in the teaching of English on the secondary level. This course should be taken concurrently with education 346: "Directed Teaching". Before taking English 359, students must pass the English Department Screening Exam and complete English 357 and education 302/303. Before taking English 359, students normally also complete Education 307 and 398.

**370 Literary Theory and Criticism (3).** S. An introduction to contemporary theories and methodologies of literary criticism with investigations into their historical origins and development. The course includes illustrations of the various methods, as well as some practical criticism.

**380 Internship in Journalism and Publishing (4).** F and S. A practicum permitting students to apply theoretical, technical, and ethical principles to specific journalistic activities. Students may be placed with the publishers of magazines or newspapers, publishing houses, or other businesses. Each student works ten hours per week under an agency supervisor and participates in seminars on campus. Prerequisites: Junior or senior status, a 2.5 college GPA, an average grade of 2.5 or higher in advanced writing courses taken (English 245, 265, 301, and 355), and permission of the English department internship supervisor.

**390 Independent Study (3).** F, I, and S. Prerequisite: permission of the department chair.

**395 Senior Seminar (3).** F and S. As the capstone course in the English major, this senior seminar is designed to nurture Christian reflection on issues related to language and literary studies, such as the significance of story and literary expression, the relationship of language and meaning, and the ethical implications of language and story. Students also consider vocational opportunities for those who love words. These contemporary literary and linguistic issues are framed by readings from within the tradition of Christian aesthetic reflection as well as from Reformed cultural criticism and theology. Prerequisites: biblical foundations I or theological foundations I, developing a Christian mind, and philosophical foundations.

**399 Honors Thesis (3).** F and S. A substantial work of research and criticism in the field of language or literature; required for those graduating with English departmental Honors.

# English as a Second Language

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These interdisciplinary minors in ESL prepare students to teach English as a second language within the U.S. or abroad. Students in elementary and secondary education programs must fulfill the requirements for the ESL education minor. Students interested in teaching abroad or in programs such as community education, literacy, or church outreach should fulfill the requirements for the non-education minor. Program advisors are K. Miller (Spanish), M. Pyper (Spanish), and E. Vander Lei (English).

## **ENGLISH AS A SECOND LANGUAGE EDUCATION MINOR (21 hours)**

Communication Arts and Sciences 216  
English 334 or Spanish 340  
English 335  
English 338  
Interdisciplinary 356 or 357  
Interdisciplinary 301/302  
Education 303

## **ENGLISH AS A SECOND LANGUAGE NON-EDUCATION MINOR (21 hours)**

Communication Arts and Sciences 216  
English 334  
English 335  
English 338  
Interdisciplinary 301 or 302  
Sociology 253  
An approved elective

Note that the ESL minor for teacher certification requires a major and that Interdisciplinary 301/302 must be taken concurrently with Education 303.

# Environmental Science, Environmental Studies

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The college offers a major program of concentration in environmental science with an emphasis in either biology, chemistry, or geology and it offers a group minor in environmental studies. The environmental science major program of concentration is intended for students who plan to pursue a career requiring scientific training in environmental problems and their solutions. The major will prepare students for jobs in a variety of fields and will prepare them for further study in certain graduate programs such as ecology, environmental science, natural resource management, or environmental biology. Students interested in environmental issues, but who wish to pursue graduate study in chemistry or geology, are encouraged to complete a disciplinary major and the environmental studies minor.

Students who major in environmental science must choose one of three emphases. Those interested in careers in environmental biology should complete the biology emphasis, those interested in careers in environmental geology should follow the geology emphasis, and those interested in careers in environmental chemistry should follow the chemistry emphasis.

The environmental studies group minor program of concentration is intended for students who are following a disciplinary major and who also have an interest in studying a broad range of environmental problems and issues at the local, national, and global levels. Because the study of such issues is truly interdisciplinary in scope, the environ-