BSCE Science/Math and Department Approved Electives List

Updated 9-19-14

For students entering the BSCE curriculum during the **2014-15 academic year**, the degree requirements include GEOE 221/L or GEOL 201, and MATH 381, and 3 credits of additional science or math electives, and 12 credits of department approved electives (15 for environmental engineering emphasis students); **9 credits of the department approved electives must be CEE-prefix classes at the 400-level or above.**

For students following the 2013-14 catalog, the BSCE degree requirements include 9 credits of science electives and 12 credits of department approved electives (15 for environmental engineering emphasis students); **6 credits of the department approved electives must be CEE-prefix classes at the 400-level or above.** The distribution of science electives is determined by ABET accreditation criteria:

> ***ABET Criterion 5. (2012-13)***
> *The curriculum requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The faculty must ensure that the program curriculum devotes adequate attention and time to each component, consistent with the outcomes and objectives of the program and institution. The professional component must include:*
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> *(a) one year [32 credits] of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline. Basic sciences are defined as biological, chemical, and physical sciences [geology, atmospheric science, physics].*
> *…*
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> *And from the Civil Engineering Program Criteria:*
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> *1. Curriculum*
> *The program must prepare graduates to apply knowledge of mathematics through differential equations, calculus-based physics, chemistry, and at least one additional area of basic science, consistent with the program educational objectives; apply knowledge of four technical areas appropriate to civil engineering; conduct civil engineering experiments and analyze and interpret the resulting data; design a system, component, or process in more than one civil engineering context; explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.*

Basic sciences are defined as biological, chemical, and physical sciences (i.e., geology, atmospheric science, and physics on our campus).

- BSCE students are required to take 6 credits of basic science or mathematics electives to meet ABET requirements.
- BSCE environmental engineering emphasis students entering SDSM&T (2013-14 catalog) take 3 credits of basic science or math electives, and Chem 230 (2 cr) and Chem 114L (1 cr) to meet ABET requirements. BSCE environmental engineering emphasis students entering SDSM&T in 2013-14 also take MATH 381 and have no additional required science electives.
- In addition, to meet the ABET Civil Engineering Program criteria, BSCE students following the civil emphasis 3 credits of an additional basic science elective in geology, atmospheric science, or biological science from the list of preapproved electives shown below (shaded in blue).
- NOTE: up to 3 credits (2014-15) or 6 credits (2013-14) of 300 or 400 level science or math classes may also be used as department approved electives.

Basic science and mathematics electives. Blue shading = course fulfills requirement for additional basic science to meet ABET Civil Engineering program criteria. Note that this list does not preclude other courses that meet the ABET criteria stated above; see your advisor if you have questions.

Course	#	Title	Credits	Prerequisites
AES	301	Introduction to Atmospheric Sciences	3	PHYS 111 or 113
AES	403/503	Biogeochemistry	3	CHEM 112, BIOL 151, PHYS 211
AES	405/505	Air Quality (spring of even years)	3	MATH 125, one semester college chemistry
AES	406/506	Global Environmental Change	3	CHEM 112, PHYS 211, BIOL 311 or POI
BIOL	151	General Biology I	3	
BIOL	153	General Biology II	3	BIOL 151
BIOL	311	Principles of Ecology	3	
BIOL	331	Microbiology	3	BIOL 151, CHEM 112
BIOL	341	Microbial Processes in Eng. and Nat. Sciences	3	CHEM 112
BIOL	371	Genetics	3	BIOL 151
BIOL	431	Industrial Microbiology	3	BIOL 231
GEOL	201	Physical Geology	3	
GEOE	221/L	Geology for Engineers	3	
Note: GEOL 201 or GEOE 221/L are required for students entering the BSCE program in 2014-15.				
CHEM	316	Fundamentals of Organic Chemistry	3	CHEM 114
CHEM	326/326L	Organic Chemistry I	3	CHEM 114
CHEM	328/328L	Organic Chemistry II	3	CHEM 326
CHEM	341	Physical Chemistry for Engineers I	2	CHEM 114 and MATH 321
CHEM	342	Physical Chemistry I	3	CHEM 114 and MATH 321
CHEM	343	Physical Chemistry for Engineers II	2	PHYS 213 and CHEM 341 or CHEM 342
CHEM	344	Physical Chemistry II	3	CHEM 342 and PHYS 213
CHEM	460/560	Biochemistry	3	CHEM 328
CHEM	482/582	Environmental Chemistry	3	CHEM 316 or 328
MATH	315	Linear Algebra	3	MATH 225 or permission of instructor
MATH	353	Linear Optimization	3	MATH 225
MATH	373	Introduction to Numerical Analysis	3	MATH 321 and CSC 150/150L
MATH	381	Introduction to Probability and Statistics	3	MATH 125, MATH 225
Note: MATH 381 is required for students entering the BSCE program in 2014-15.				
MATH	382	Probability Theory and Statistics II	3	MATH/IENG 381
MATH	447	Design of Experiments	3	MATH 382 or MATH 442 or POI
PHYS	213	Physics II	3	PHYS 211

The BSCE curriculum includes 12 (15 for environmental emphasis students) credit hours of Department Approved Electives that students may use to broaden their education in many civil engineering areas, gain knowledge and skills in a specialized area of civil engineering or create a knowledge base tailored to their individual career goals. Department Approved Electives may include the following:

- **At least 6 credits of CEE 400-level coursework not applied to another CEE graduation requirement for students following the 2013-14 catalog.** Classes cross-listed with CEE prefix courses also meet this requirement.

- **At least 9 credits of CEE 400-level or above coursework not applied to another CEE graduation requirement for students entering 2014-15.** Classes cross-listed with CEE prefix courses also meet this requirement.

- Up to 6 credit hours of CEE 498 (Undergraduate Research/Scholarship), CEE 491 (Independent Study) or CP 497 (Cooperative Education); not more than 3 credits may be CEE 491 or CP 497. Students taking CEE 498 must work with a faculty member and submit a summary of their research/scholarship/independent study plans to the CEE department head prior to enrolling. The form is available here: http://www.sdsmt.edu/Academics/Departments/Civil-and-Environmental-Engineering/Roadmap-To-Success/.

- Up to 3 credit hours of 300, 400, 500 or 600-level courses in engineering, science, math or computer science not applied to another BSCE graduation requirement (6 credits for BSCE - environmental engineering emphasis students). Accelerated MS CENE degree students may take 500 and 600-level courses.

300, 400, 500-level CEE Department Approved Electives			**Credits**	**Prerequisites**
CBE	317	Chemical Engineering Heat Transfer	3	CBE 218, CBE 250, MATH 321
CBE	318	Chemical Engineering Mass Transfer	3	CBE 317 or ENVE 315
Note: CBE 317 and 318 are required courses in the BSCE Environmental Engineering emphasis track and cannot be used by EnvE emphasis students as electives.				
CBE	321	Chemical Engineering Equilibrium Thermodynamics	3	CBE 222, MATH 225
CBE	343	Chemical Kinetics and Reactor Design	3	CBE 317, CBE 321
CBE	417	Chemical Engineering Equilibrium Separations	2	CBE 321
CBE	434/434L	Design of Separation Processes	2	CBE 318
CBE	444/544	Reactor Design	3	CBE 343, CBE 250
CBE	455/555	Pollution Phenomena and Process Design	3	CBE 218, CBE 317, CBE 417
CBE	484/584	Fundamentals of Biochemical Engineering	3	CBE 343, BIOL 231 or 341
CBE	492	Topics	1-3	
CEE	425/525	Sustainable Engineering	3	
CEE	426/526	EnvE Engr: Physical/Chemical Process Design	3	CEE/EnvE 326
CEE	427/527	Enve Engr: Biological Process Design	3	CEE/EnvE 327
CEE	428	Oil and Gas Development and the Environment	3	

CEE	433/533	Open Channel Flow	3	CEE 336
CEE	437/537	Watershed/Floodplain Modeling	3	CEE/ENVE 337
CEE	447/547	Foundation Engineering	3	CEE 346/346L
CEE	448/548	Applied Geotechnical Engineering	3	CEE 347
CEE	451/451L 551/551L	Design of Wood Structures	3	CEE 353
CEE	453/553	Steel Design	3	CEE 353
CEE	457/457L	Indeterminate Structures	3	CEE 353
CEE	491	Independent Study	1-3	Permission of instructor
CEE	492	Topics	1-3	
CEE	498	Undergraduate research	1-6	Permission of instructor
GEOE	324	Engineering Geophysics I	3	MATH 125 PHYS 213
GEOE/CEE	421/521	Aqueous Geochemistry	3	CHEM 114
GEOE	425/525	Engineering Geophysics II	3	MATH 125, GEOE 324, GEOE 211
GEOE	461	Petroleum Production	3	
GEOE	462	Drilling and Completion Engineering	3	EM 321
GEOE	466/566	Engineering and Environmental Geology	3	Junior or senior standing
GEOE	468/568L	Geohazards	3	CEE 346/346L
GEOE/CEE	475	Ground Water	3	GEOL 201 or 221, MATH 225
GEOE	482	Applied Geomorphology	3	GEOL 201 or 221, GEOL 322
GEOE	492	Topics	1-3	
GEOL	351	Earth Resources and the Environment	3	GEOL 201 or 221
GEOL	416/516	Introduction to GIS	3	
GEOL	442/542L	Optical Petrology	3	GEOL 341/341L or GEOL 314/314L

IENG	321	Ergonomics/ Human Factors Engineering	3	PSYC 101, MATH 281 or IENG/MATH 381
IENG	331	Safety Engineering	3	Junior or senior standing
IENG	345	Entrepreneurship	4	ACCT 211 and IENG 301 or 302 or Permission of Instructor
IENG	352	Creativity and Innovation	1	
IENG	366	Engineering Management	3	
IENG	425	Production and Operation	3	MATH 123, IENG/MATH 381 or BADM 221
IENG	431/531	Industrial Hygiene	3	Senior or graduate standing
IENG	451	Operational Strategies	3	Junior standing
IENG	475	Computer-Controlled Manufacturing Systems and Robotics	3	Senior standing
ME	428/428L	Applied Finite Element Analysis	3	ME 312, ME 313, ME 316, ME 322, ME 331, ME 351/351L, ME 352
ME	430	Wind Engineering	3	ME 312, ME 313/313L, ME 316, ME 322, ME 331, ME 351/351L; ME 352 or permission of instructor
ME	432/532L	Experimental Stress Analysis	4	ME 322
ME	443	Composite Materials	3	ME 316 or concurrent enrollment in MET 440
MEM	307	Mineral Exploration and Geostatistics	3	Junior standing
MEM	405	Mine Permitting and Reclamation	3	Junior standing
MEM	466	Mine Management	2	Senior standing
MET	310,310L	Aqueous Extraction, Concentration and Recycling	4	MET 320 or CBE 321 or CHEM 342
MET	321,321L	High Temperature Extraction, Concentration, and Recycling	4	MET 320
MET	422	Transport Phenomena	4	MATH 321, MET 320
NANO	401	Introduction to Nanoscience	3	PHYS 213/213L, CHEM 114, MATH 321
NANO	445/545	Introduction to Nanomaterials	3	MET 232, EM 321
NANO	475/575	Advances in Processing and Nanoengineering of Polymers	2	CHEM 114/114L or MES 604
Additional 500- and 600-level department approved electives for students in the accelerated MSCE program			**Credits**	**Prerequisites**
CM	608	Construction Contracts	3	None
CM	610	Construction Project Mgmt	3	Graduate standing
CM	619	Construction Company Mgmt	3	None

CM	665	Construction Equipment Mgmt	3	Graduate standing
CEE	634	Surface Water Hydrology	3	CEE 337 or permission of instructor
GEOE	615	Adv. Field Methods in Ground Water	3	GEOE 475/475L or equivalent
GEOE	626	Environmental Geophysics	3	None
GEOE	641	Geochemistry	3	None
GEOE	662	Anal. Meth in GW	3	GEOE 475/475L or equivalent
GEOE	663	Ground Water Geochemistry	3	GEOE 475/475L or equivalent
GEOE	664	Adv. Ground Water	3	GEOL 201 or GEOE 221/221L or equivalent
GEOE	682	Fluvial Processes	3	None
ME	532	Experimental Stress Analysis	3	ME 322 or permission of instructor
MATH	547	Design of Experiments	3	MATH/IENG 382 or MATH 442 or permission of instructor
MATH	451/551	Mathematical Modeling		MATH 321 or permission of instructor.

AES 301 Introduction to Atmospheric Sciences - Basic physical principles are applied to the study of atmospheric phenomena. Topics covered include the structure of the atmosphere, radiative processes, atmospheric motions, meteorological processes, air masses, fronts, weather map analysis, weather forecasting, and severe storms including thunderstorms, hail, tornadoes, hurricanes, and blizzards.

AES 403/503 Biogeochemistry - The earth system is tightly connected through biogeochemical interactions. This course will present a multi-disciplinary array of intermediate and advanced topics in terrestrial, aquatic, and atmospheric biogeochemistry. Instantaneous to decadal time-scale interactions of carbon, water, and multiple nutrient cycles will be discussed, and a critical survey of the state-of-the-art field modeling, and remote sensing methods for studying biogeochemical cycles will be presented.

AES 405/505 Air Quality - Up-to-date problems and trends in urban air quality, global effects of environmental pollution, effects of air pollutants on weather processes, the technology of pollutant production, and pollutant dispersal. A treatment of the chemistry and physics of reactions involving primary air pollutants is included.

AES 406/506 Global Environmental Change - Major global environmental changes will be addressed using an interdisciplinary approach. Topics will include basic processes and principles of ecosystems, biogeochemical cycles, major climate controls, and atmospheric chemistry and feedbacks between climate and various earth system processes.

BIOL 151 General Biology - The introductory course for those majoring in biology and microbiology. This course presents the concepts of cell biology, evolution, heredity, molecular genetics and ecology.

BIOL 153 General Biology II - A continuation of General Biology I and presents the concepts of animal and plant structure and function, energetics, and reproduction.

BIOL 311 Principles of Ecology - Basic principles of ecology including the sub disciplines of physiological ecology, population ecology, community ecology, evolutionary ecology, and ecosystems ecology from both a theoretical and applied aspect.

BIOL 331 - Basic principles of ecology including the sub disciplines of physiological ecology, population ecology, community ecology, evolutionary ecology, and ecosystems ecology from both a theoretical and applied aspect.

BIOL 341 Microbial Processes in Eng. And Nat. Sciences - This course introduces and develops important fundamental topics including: microbial structure and chemistry; cellular metabolism; and intercellular processes and extracellular conditions that control microbial behavior, leading to applications such as biocatalysis, biofuels production, environmental bioremediation, food processing, microbial ecology, pharmaceuticals production, environmental microbiology, and wastewater renovation.

BIOL 371 Genetics - Principles governing the nature, transmission and function of hereditary material with application to plants, animals, humans, and microorganisms.

BIOL 431 Industrial Microbiology - The roles of microbes in nature, industry, and public health are considered. Application of microbiology to engineering is emphasized. Concurrent registration in BIOL 431L recommended but not required.

CBE 317 Chemical Engineering Heat Transfer - The third course on the theory and practice of chemical engineering with emphasis on heat transfer. Heat transfer by conduction, convection, and radiation is studied. (Elective for civil emphasis only)

CBE 318 Chemical Engineering Mass Transfer - The fourth course on the theory and practice of chemical engineering with emphasis on molecular diffusion, membranes, convective mass transfer, drying, humidification, and continuous gas-liquid separation processes. (Elective for civil emphasis only)

CBE 321 Chemical Engineering Equilibrium Thermodynamics - A continuation of CBE 222 with emphasis on the second and third laws of thermodynamics. Emphasis on thermodynamic properties of fluids, flow processes, phase and chemical equilibria.

CBE 343 Chemical Kinetics and Reactor Design - A study of chemical kinetics and reactor design, including techniques for analyzing kinetic data, choosing reactor operating parameters, economic optimization of homogeneous reactions, and reactor modeling.

CBE 417 Chemical Engineering Equilibrium Separations - The fifth course on the theory and practice of chemical engineering with emphasis on equilibrium staged separations.

CBE 434/434L Design of Separation Processes - Separation technology and processes are studied with application to current industrial design problems. Topics and design case studies may include: absorption, adsorption, biological separations, crystallization, distillation, environmental

separations, ion exchange, membrane separations, molecular distillation, pervaporation, solid separations, supercritical extraction, thermal stripping, and others.

CBE 444/544 Reactor Design - Applications of chemical engineering principles to reactor design. Emphasis includes: non-isothermal reactor modeling, homogeneous and heterogeneous reactors, economic and performance optimization, catalysis, and computer simulation.

CBE 455/555 Pollution Phenomena and Process Design - The study of the industrial sources of and treatment of air, water, and land pollutants. The chemical and physical phenomena operating in pollution control equipment and the design of pollution control equipment will be examined. Waste minimization and pollution prevention strategies will be considered.

CBE 484/584 Fundamentals of Biochemical Engineering - An introduction to the characterization of microorganisms, fermentation pathways, unit processes in fermentation, biochemical kinetics, and batch and continuous fermentation. The basic engineering concepts of fermentation, separation, control, and operations will be discussed.

CBE 492 Topics - Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. A maximum of 6 credits of special topics will be allowed for degree credit.

CEE 425/525 Sustainable Engineering - This course will serve as an introduction to the emerging field of sustainable engineering, with focus on understanding interactions between industrial processes and the environment. Identification and implementation of strategies to reduce the environmental impacts of products and processes associated with industrial systems will be explored and evaluated using tools such as life cycle analyses and materials balances. The course will also explore appropriate sustainable technologies employed within both developing and first world countries.

CEE 426/526 EnvE Engr: Physical/Chemical Process Design (3-0) 3 credits. Prerequisites: CEE 326. A third course in the theory and practice of environmental engineering. Emphases are on the design and analysis of physical/chemical environmental engineering unit operations and processes.

CEE 427/527 EnvE Engr: Biological Process Design (3-0) 3 credits. Prerequisites: CEE 327/327L. A fourth course in the theory and practice of environmental engineering. Emphases are on the design and analysis of biological environmental engineering unit operations and processes.

CEE 428 Oil and Gas Development and the Environment (3-0) 3 credits. This course explores environmental issues related to oil and gas development, including potential groundwater contamination, drilling solid waste and wastewater treatment and disposal, atmospheric pollution, and unintentional releases.

CEE 433/533 Open Channel Flow - Application of continuity, momentum, and energy principles to steady flow in open channels; flow in the laminar and transition ranges; specific energy and critical depth; energy losses; channel controls; gradually and rapidly varied flow; and high velocity flow.

CEE 437/537 Watershed/Floodplain Modeling - This course will consist of the application of the HEC-HMS Flood Hydrograph Package and HEC-RAS Water Surface Profiles computer programs. Each model is applied to an actual watershed and conveyance channel. The student is responsible for two project reports, one for each model application. Data compilation and model development and execution will be conducted in the lab portion of the class. Development of the model inputs will include review of hydrologic and hydraulic processes relating to model options.

CEE 447/547 FOUNDATION ENGINEERING (3-0) 3 credits. Prerequisites: CEE 346/346L. Application of the fundamental concepts of soil behavior to evaluation, selection, and design of shallow and deep foundation systems. Related topics such as temporary support systems for excavations and pile driving are also included. Students enrolled in CEE 547 will be held to a higher standard than those enrolled in CEE 447.

CEE 448/548 APPLIED GEOTECHNICAL ENGINEERING (3-0) 3 credits. Prerequisites: CEE 347. Content will include the application of principles taught in CEE 346 and CEE 347 to practical geotechnical engineering problems in the civil engineering profession, such as exploration, pavement design, slope stability, geosynthetics, geotechnical problems unique to the region, and dam design. Students enrolled in CEE 548 will be held to a higher standard than those enrolled in CEE 448.

CEE 451/451L/551/551L DESIGN OF WOOD STRUCTURES (2-1) 3 credits. Prerequisites: CEE 353. This course will cover the behavior and properties of timber, lumber and pre-engineered structural wood products. Students will learn to design members and systems using current methods and appropriate codes and specifications. An additional research requirement will be included for those taking the class for graduate credit. The course includes a lecture component complemented by a computational laboratory. Students enrolled in CEE 551 will be held to a higher standard than those enrolled in CEE 451.

CEE 453/553 DESIGN OF STEEL STRUCTURES (2-1) 3 credits. Prerequisites: CEE 358 and CEE 457/457L. Analysis and design of structural elements and connections for buildings, bridges, and specialized structures that utilize structural metals. Behavior of structural systems under elastic and plastic design.

CEE 457/457L INDETERMINATE STRUCTURES (2-1) 3 credits. Prerequisites: CEE 353. Analysis of indeterminate structures by classical and matrix methods. The classical methods are the force method, the slope-deflection equations and the moment-distribution method. The classical methods also are used to determine influence lines for indeterminate structures. Stiffness matrices for truss and beam elements are derived and used to analyze trusses, beams, and frames.

CEE 491 INDEPENDENT STUDY 1 to 3 credits. Prerequisites: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Meeting frequency depends on the requirements of the topic.

CEE 492 TOPICS 1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors.

CEE 498 UNDERGRADUATE RESEARCH/SCHOLARSHIP 1 to 6 credits. Prerequisites: Permission of instructor. Includes senior project, and capstone experience. Independent research problems/projects or scholarship activities. The plan of study is negotiated by the faculty member and the student. Contact between the two may be extensive and intensive. Does not include research courses which are theoretical.

CEE 634 Surface Water Hydrology - Review and advanced study of hydrologic cycle including precipitation, infiltration, evapotranspiration, and runoff. Applications to analysis and design of water supplies, reservoirs, spillways, floodways, urban runoff, and protection systems.

CHEM 316 Fundamentals of Organic Chemistry - A one-semester introductory course in organic chemistry. Functional classes of organic compounds are discussed in terms of characteristic functional group, properties, structure, nomenclature, synthesis, and reactivity.

CHEM 326/326L Organic Chemistry I - A systematic treatment of the chemistry of carbon compounds, including nomenclature, structure-reactivity relationships, reaction mechanisms, synthesis, and spectroscopy.

CHEM 328/328L Organic Chemistry II - A systematic treatment of the chemistry of carbon compounds, including nomenclature, structure-reactivity relationships, reaction mechanisms, synthesis, and spectroscopy.

CHEM 341 Physical Chemistry for Engineers I - Physical transformations of pure substances; simple mixtures and phase diagrams; chemical equilibrium and equilibrium electrochemistry.

CHEM 342 Physical Chemistry I - A study of the fundamental principles governing the behavior of chemical systems. Topics covered in the two-semester sequence include thermodynamics, chemical kinetics, quantum mechanics, and statistical mechanics. Properties of gases; first and second laws of thermodynamics; physical transformations of pure 2011-2012 Catalog 250 Course Descriptions substances; simple mixtures and phase diagrams; chemical equilibrium and equilibrium electrochemistry.

CHEM 343 Physical Chemistry for Engineers II – Kinetic theory of gases; statistical thermodynamics and properties of solids; chemical kinetics and kinetics at interfaces.

CHEM 344 Physical Chemistry II - A continuation of Physical Chemistry I. A study of the fundamental principles governing the behavior of chemical systems. Kinetic theory of gases; statistical thermodynamics and properties of solids; chemical kinetics and kinetics at interfaces; quantum mechanics and spectroscopy.

CHEM 460/560 Biochemistry - A one-semester course in biomolecules, metabolism, and transmission of genetic information. The structures, properties, and biochemical functions of mono- and polysaccharides, lipids, amino acids, proteins, and nucleic acids are introduced. Metabolic

pathways and cycles for the catabolism and anabolism of sugars, triglycerides, steroids, amino acids, proteins, and polynucleotides are detailed. Energetics, the potential fates of chemical intermediates, and information storage and transmission are studied.

CHEM 482/582 Environmental Chemistry - Examination of the chemistry and chemical processes of the environment, including the role of chemistry in current environmental issues.

CM 608 Construction Contracts - Course addresses the fundamentals of contract law and in-depth treatment of construction topics which most frequently result in litigation. Guidelines and documents such as CSI, AIA, AGC, and CONSENSUS DOCS will be examined to clarify important concepts. CSC 410/510 Parallel Computing - The fundamental ideas and issues involved in programming and using parallel computers. A survey of modern architectures and operating systems. Parallel programming applications in business, economic modeling, and science. The School of Mines emphasizes scientific applications.

CM 610 Construction Project Management - Course addresses advanced study and application of estimating, scheduling, and project control principles utilized within the construction industry. Course will make extensive use of computer modeling in the analysis and development of realistic construction estimates and schedules. Conceptual, assembly, and detailed estimating topics are addressed. Network, linear, matrix, and bar chart schedules are analyzed. Project control topics including cost, resource, and schedule control are addressed and applied to cash flow analysis, project duration optimization, and resource balancing problems.

CM 619 Construction Company Management - Students will study topics as they relate to managing a construction company. These include financial management, strategic planning, business development, human resources management, information management, quality management, and risk management.

CM 665 Construction Equipment Management - Course addresses equipment and methods used in building, heavy-highway and utility construction; equipment and crew productivity; ownership and operating costs; production rates and operating characteristics of major construction equipment and operations. Critical thinking, leadership and management skills, written and verbal communication, and listening skills vital to the role and responsibilities of a professional constructor are developed and enhanced.

GEOE 221 Geology for Engineers - Basic concepts in the study of the earth, with emphasis on geological processes acting on the earth’s surface. Topics include rock forming processes and identification, mass wasting, ground water, streams, glaciers, coastal erosion, and earthquakes. Emphasis is given to engineering significance of processes and their resulting deposits.

GEOE 324 Engineering Geophysics I - Application of the more commonly used methods of geophysical prospecting in mineral exploration, petroleum exploration, and engineering construction. Includes field design and interpretation of surveys using the engineering seismograph, gravity meter, electrical resistivity equipment, scintillometers, and magnetometers. Extensive use of computers is made in the laboratory work.

GEOE/CEE 421/521 Aqueous Geochemistry – Geochemical principles and applications for aqueous systems, including water quality and mass transport. Topics will include thermodynamics, carbonate equilibria, silica solubility, redox reactions, pE-pH relationships, and partial pressure diagrams. Geochemical modeling software will be used in projects.

GEOE 425/525 Engineering Geophysics II - The course concentrates on geophysical techniques applicable to petroleum exploration and production, including the acquisition of seismic data, its preparation, interpretation, and use in engineering design. Use of computer packages and individual program design is emphasized.

GEOE 461 Petroleum Production - Characteristics of hydrocarbon reservoirs and geological considerations in well completion design. Well in-flow performance. Tubing string and packer completion design. Design and analysis of artificial lift systems. Acidizing and stimulation operations Computer-aided design. Single-phase and multi-phase flow measurements, physical modeling of oil production, and permeability tests. Global oil production and use, and societal implications.

GEOE 462 Drilling and Completion Engineering - Introduction to modern oil and gas field terminology. Topics include design and analysis of oil or gas well drilling operations (including horizontal and casing drilling), interpretation of wellbore and formation properties using geophysical logging techniques, casing design, cementing, and perforating. Computer-aided design for well control, hydraulics, and logging. Field trip to a local drilling operation is available.

GEOE 466/566 Engineering and Environmental Geology - The application of geology to engineering, including topics such as landslides, earthquakes, fluvial processes, land subsidence, and their global context. Field trips and laboratory exercises illustrate the influence of geology on the environment. Computer applications are required for problem assignments and a final comprehensive report (oral and written) involving the design of engineering works in complex geological terrain.

GEOE 468/468L/568/568L Geohazards - A comprehensive analysis of the mechanisms behind geologic processes that affect the human environment in catastrophic ways. Topics include earthquake and volcanic hazards, mass movements, and land subsidence. Assignments, labs, and final projects will be focus on rigorous analyses using common industry-utilized software packages to monitor and mitigate these hazards. Field experiences will allow students to apply the principles discussed to real-world situations.

GEOE/CEE 475 Ground Water - Geohydrologic principles, applications, and design considerations concerning ground-water occurrence, flow, and quality. Ground-water and surface-water relations; theory of aquifer tests; flow nets; head distribution by graphical, analytical, and digital models; ground-water contamination. Laboratories include water budgets, chemistry of ground water, design of exploration programs and aquifer tests, computer solutions, and field trips to areas of geohydrologic interest. A design project with written and oral presentations is required. This course is cross-listed with ENVE 475/475L.

GEOE 482 Applied Geomorphology - A systematic analysis of landform evolution with emphasis on process and terrain analysis. Topics include process-response in geomorphic systems and quantitative techniques used in engineering design applications. Laboratory consists of aerial photos,

topographic map interpretation and the application of geomorphology as an engineering tool. Field trips taken to regional areas of interest. Computer solutions in engineering analysis and a design project are required.

GEOE 492 Topics - Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. A description of the work to be performed must be filed in the Department of Geology and Geological Engineering.

GEOE 615 Advanced Field Methods in Geology - Advanced instruction and independent work involving field techniques such as aquifer mapping, water quality sampling and interpretation, piezometer tests, and the design, conduct, and analysis of aquifer tests.

GEOE 626 Environmental Geophysics –

GEOE 641 Geochemistry - Geochemical principles, applications, and design considerations, including thermodynamics, kinetics, and transport phenomena. Applications in low-temperature aqueous systems, carbonate equilibria, geothermal and hydrothermal systems, petroleum generation, metamorphism, and igneous processes. Computer solutions to geochemical problems will be used. An engineering design project is required.

GEOE 662 Analytical Methods in Ground Water - Quantitative methods used to evaluate ground-water resources, including pumping tests as well as physical and computer methods.

GEOE 663 Ground Water Geochemistry - A study of the natural chemistry of ground water and the effects of man's activities on ground-water quality. Laboratories include dispersion experiments and several field trips to areas of interest relating to ground-water geochemistry.

GEOE 664 Advanced Ground Water - Basic hydrologic principles with emphasis on hydrologic and geologic interrelationships. Design problems of location, development, and conservation of ground water. Use of quantitative techniques for aquifer evaluation. Studies of ground-water contamination. Laboratories, field trips, and problem assignments require use of analytical methods.

GEOE 682 Fluvial Processes - The systematic study of watershed evolution and the development and function of the attendant stream composition. Emphasis is placed on morphometry, quasi-equilibrium, classification, fluvial mechanics, fluvial landforms, and stream restoration technology. Study and discussion of current literature will focus on process and results. Students will partake in lecture presentation of specified topics.

GEOL 201 - Basic concepts in the study of the earth and its history. Brief introduction of the earth's place in the universe and solar system and the evolution, composition and structure of the earth. Introduction to minerals, and igneous, sedimentary and metamorphic rocks. Survey of geological processes acting at the surface of earth such as wind, rivers, glaciers, ground water, and the sea; introduction to internal processes regarding plate tectonics theory and growth of mountains. Societal implications of geological processes are emphasized throughout the course.

GEOL 351 Earth Resources and the Environment - This course will examine the distribution, origin, use, and future of earth's energy, metallic, and non-metallic resources. Economic, political, sociological, and environmental implications of the resource industries will be emphasized. Resource issues of topical interest will be discussed.

GEOL 416/516 Introduction to GIS - Introduction to principles and applications of geographic information systems (GIS) including data management and analysis. Laboratory work will include introduction to PC-based GIS software and data sets. Students are expected to have basic computer system, word processing, and spreadsheet skills prior to taking the class.

GEOL 442/442L/542/542L Optical Petrology - The study of igneous, sedimentary, and metamorphic rocks and ore samples in thin and polished section, with emphasis on their identification, classification, and genesis.

IENG 321 Ergonomics/Human Factors Engineering - Topics covered include: Engineering anthropometry , workplace design, biomechanical modeling, work kinesiology, and musculoskeletal disorders, cognitive engineering and office ergonomics.

IENG 331 Safety Engineering - Overview to the field of Safety Engineering emphasizing quantitative problem solving. Will draw on fundamental knowledge from the fields of chemistry, physics, mechanics, mathematics, and statistics. Contents: fundamental concepts and terminology, injury and accident statistics, ethics, certification, regulations, standards, hazards and their control, and management aspects.

IENG 345 Entrepreneurship – This class covers topics on the legal aspects, management skills, business plans, and sources of capital as well as case studies of successful and unsuccessful entrepreneurial initiatives.

IENG 352 Creativity and Innovation - This course focuses on the Herrmann Whole Brian model and creative thinking to strengthen team processes and the tools necessary for product and process innovations. Students will receive an exposure to the whole brain model and to a variety of problems that will require more creative and innovative thought processes to solve the problem.

IENG 366 Engineering Management – A course designed to acquaint the student with engineering management discipline through the formation and operation of business and industrial enterprises. In addition to engineering management decision tools, students will be exposed to emergent trends in learning organizations, systems thinking, change management, and processes utilizing all four quadrants of Herrmann Whole Brian model for advanced problem solving.

IENG 381 Intro to Prob and Stat – Introduction to probability, discrete and continuous distributions, sampling distributions, central limit theorem, and general principles for statistical inference.

IENG 425 Production and Operation - Management of the production environment. Topics such as bills of materials, inventory control, production control, production scheduling and MRP will be discussed. The impact of production management on the design process and how products can be designed for better manufacture.

IENG 431/531 Industrial Hygiene - Principles of industrial hygiene, including the identification and evaluation of chemical, physical, and biological agents which affect the health and safety of employees; the application of control measures for the various agents; study of threshold limit values and occupational health toxicology.

IENG 451 Operational Strategies - Review of philosophies, systems, and practices utilized by world-class organizations to meet current operational challenges. Focuses include “lean production” in the manufacturing industries, including material flow, plant-floor quality assurance, job design, work and management practices as well as the most effective practices in the service industries. Students complete lab projects and tour organizations to analyze the extent and potential of the philosophies.

IENG 475 Computer-Controlled Manufacturing Systems and Robotics - Fundamental concepts of using computers in the design of a computer integrated, discrete-item, manufacturing facility are covered. Basic ideas of Computer Aided Design (CAD), Group Technology (GT), process planning, integrated production control and computer numerical control are covered. The manufacturability issues and concepts of selecting and using robots in the workplace are explored.

MAT 315 Linear Algebra - Course topics include: the theory and applications of systems of linear equations, matrices, determinants, vector spaces, linear transformations and applications.

MATH 353 Linear Optimization – Convex sets and functions, linear inequalities and combinatorial problems; topics in linear programming from fundamental theorems of simplex method through sensitivity analysis, duality, transportation, and assignment problems.

MATH 373 Introduction to Numerical Analysis - This course is an introduction to numerical methods. Topics include elementary discussion of errors, polynomial interpolation, quadrature, non-linear equations, and systems of linear equations. The algorithmic approach and efficient use of the computer will be emphasized. Additional topics may include: calculation of eigenvalues and eigenvectors, numerical differentiation and integration, numerical solution of differential equations.

MATH 382 Probability Theory and Statistics II - Review of general principles of statistical inference, linear regression and correlation, multiple linear regression, ANOVA, and statistical design of experiments.

MATH 451/551 Math Modeling - The primary goal of this course is to present the mathematical formulation and analysis utilized in scientific modeling. Applications from both science and engineering will be covered. The types of models will include deterministic and stochastic models. Topics may include: epidemiology, biomass, elasticity, heat flow, electrical circuits, mechanical vibrations and optimization.

MATH 447/547 Design of Experiments - Single and multifactor experiments, analysis of variance, factorial designs, the use of multiple regression, and response surface methodology. Topics may include nonparametric and permutation / randomization alternatives to the traditional parametic tests.

ME 428 Applied Finite Element Analysis - Basic mathematical concepts of finite element analysis will be covered. The students will learn finite element modeling using state of the art software, including solid modeling. Modeling techniques for beams, frames, two and three- dimensional solids, and then walled structures will be covered in the course.

ME 430 Introduction to Wind Energy - The course is an introduction to the theory of and the basic concepts of modern wind energy converters. Various types of wind power generators are discussed and in particular horizontal and vertical axis turbine rotors. Other core subjects are; wind energy conversion, the effect of lift and drag, Betz's Momentum Theory, and an introduction to rotor aerodynamics. Concepts of wind, wind prediction, boundary layers, wind loads, and turbulences will be covered. Rotor blades, material selection, airfoils, loads, stresses, failure modes, control systems, and wind energy distribution are also introduced.

ME 432/532 Experimental Stress Analysis - An introduction to experimental methods for determining stresses inside mechanical components from measuring their deformations, and related topics. Topics: Review of stress/strain analysis, analysis of experimental data, data acquisition, strain gages, introduction photoelasticity, and digital image correlations.

ME 443 Composite Materials - This course will cover heterogeneous material systems; basic design concepts and preparation; types of composite materials; advances in filaments, fibers and matrices; physical and mechanical properties; failure modes; thermal and dynamic effects; and application to construction, transportation and communication.

MEM 307 Mineral Exploration and Geostatistics - The application of the theory of geostatistics to qualify the geological concepts of (1) area of influence of a sample, (2) the continuity of the regionalized variable within a deposit, and (3) the lateral changes in the regionalized variable according to the direction. Basic concepts and theory of probability and statistics will be introduced, including probability distributions, sampling distributions, treatment of data, the mean, variance, and correlation. Computer techniques will be extensively used for geostatistical estimation of grade, volume, and variance. This course is cross-listed with ENVE 307.

MEM 405 Mine Permitting and Reclamation - A study of environmental problems associated with both surface and underground mining and the reclamation practices that have been developed or are being evaluated to alleviate these problems. Federal, state and local reclamation regulations are examined for their effects on present and future mining practices and costs. Field trips to mining operations in the Black Hills region or the Powder River Basin will be taken for on-site observation of actual reclamation practices.

MEM 466 Mine Management - The study of critical management issues of fundamental importance to the mining industry: forms of management, organizational structures, project management and mine administration, risk management, and modern management tools. Development of leadership skills. Management of human resources.

MET 310/310L Aqueous Extraction, Concentration and Recycling - Scientific and engineering principles involved in the winning of metals from ores and scrap. Areas covered include the unit operations of comminution, sizing, solid/liquid separations, leaching, ion exchange, solvent extraction, and surface phenomena as related to flocculation, froth floatation, and electrostatic separation.

MET 321/321L High Temperature Extraction, Concentration, and Recycling - Thermodynamic principles involved in the winning of metals. Areas covered include calcination, oxidation, reduction processes, smelting, high -temperature refining, electrorefining, slags, and slag-metal interactions.

MET 422 Transport Phenomena - The principles of momentum, heat and mass transfer and their application to metallurgical engineering. Topics covered include thermal conductivity, mass diffusion, mechanisms of transport, Fourier's and Fick's Laws, shell balance, boundary conditions, equations of change, unsteady-state transport, mass and heat distributions in turbulent flow, and interphase transport.

NANO 401 Introduction to Nanoscience - Introduction to the concepts, motivations, and challenges of nanoscience. Topics include the emergence and background of nanoscience. Properties, applications, and characterization of nanoscale materials and systems will be examined. The course will particularly benefit students considering graduate studies that may involve nanotechnology research. Principles of basic physics, chemistry, and mathematics will be involved.

NANO 445/545 Introduction to Nanomaterials- This course will introduce the theoretical basis and synthetic processes of nanomaterials. Specifically, this course will focus on the synthesis and fabrication of nanostructures and nanomaterials, and also include content on the nanoscale property measurements. Finally, the course will cover applications of nanomaterials, particularly focusing upon inorganic nanomaterials.

NANO 475/575 Advances in Processing and Nanoengineering of Polymers - The course will begin with an overview of the basic principles of polymer rheology and structure formation. It will then review recent examples from the scientific literature in which concepts and theories of rheological behavior and structure formation at multiple length scales have been further developed and/or applied to the processing of polymers and composites with advanced functional and multifunctional properties. Special attention will be paid to research related to processing challenges in the formation of polymer nanocomposites, nanofibers and heirarchial composite structures. As part of this course, students will be expected to develop skills in reviewing and critically assessing the scientific literature, and in developing research strategies based on current state of knowledge.

PHYS 213 University Physics II - This course is the second course in a two semester calculus-level sequence, covering fundamental concepts of physics. This is the preferred sequence for students majoring in physical science or engineering. Topics include electricity and magnetism, sound, light, and optics.