LA 482 Evaluating Social and Behavioral Factors for Open Space Design (3)
User oriented approach to open space design. Interview and survey techniques, behavioral trace mapping and systematic observation, post occupancy evaluation and similar methods are used to generate user input and feedback in the design process. Understanding the behavioral implications of designed environments. 2 lectures, 1 laboratory.
Prerequisite: Fourth-year or graduate standing or consent of instructor.

LA 483 Special Studies in Landscape Architecture (1–12)
Special issues and problems through research, field trips, seminars and other forms of investigation and involvement. Course requirements are determined prior to each individual project through a contractual agreement between students and department. Departmental Off Campus Study Program guidelines apply. Total credit limited to 36 units. 1–12 activities. Prerequisite: Fourth- or fifth-year standing, or consent of instructor.

LA 485 Cooperative Education Experience (6) (CR/NC)
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Junior standing and consent of instructor.

LA 495 Cooperative Education Experience (12) (CR/NC)
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Junior standing and consent of instructor.

LA 551 Regional Landscape Assessment I (4)
Definition, research and filing of data covering the biological, cultural and physical resources of a specific region. Concepts of regionalism, land planning, reclamation and preservation are integral to the course. Utilization of mainframe and microcomputer facilities and software. 4 laboratories. Prerequisite: Graduate standing or consent of instructor.

LA 552 Regional Landscape Assessment II (4)
Application of data manipulation techniques in order to model both impacts on natural systems and land development potentials. Use of planning strategies to predict outcomes resulting from the land use decision process. Utilization of mainframe and microcomputer facilities and software. 4 laboratories. Prerequisite: LA 551 and graduate standing.

LA 585 Cooperative Education Experience (6) (CR/NC)
Advanced study analysis and part-time work experience in student's career field; current innovations, practices, and problems in administration, supervision, and organization of business, industry, and government. Must have demonstrated ability to do independent work and research in career field. Total credit limited to 9 units. Credit/No Credit grading only. Prerequisite: Graduate standing and consent of instructor.

LA 595 Cooperative Education Experience (12) (CR/NC)
Advanced study analysis and full-time work experience in student's career field; current innovations, practices, and problems in administration, supervision, and organization of business, industry, and government. Must have demonstrated ability to do independent work and research in career field. Total credit limited to 9 units. Credit/No Credit grading only. Prerequisite: Graduate standing and consent of instructor.

LA 595 Cooperative Education Experience (12) (CR/NC)
Advanced study analysis and full-time work experience in student's career field; current innovations, practices, and problems in administration, supervision, and organization of business, industry, and government. Must have demonstrated ability to do independent work and research in career field. Total credit limited to 9 units. Credit/No Credit grading only. Prerequisite: Graduate standing and consent of instructor.

LIB–LIBRARY

LIB 101 Library Instruction (1)
Instruction and practice in the use of the on-line catalog, reference books, periodical indexes, government documents, and other library materials. Development of student independence and initiative in using the library as a source of information. 1 lecture.

LIB 302 Library Resources and Literature Searches (1–4)
Sources of information and search strategies in major subject fields. Reference materials, bibliographic aids, indexing and abstracting tools, and Internet sources. Evaluation of sources. Class Schedule will list major subject area covered. Total credit limited to 4 units. 1–4 lectures. Prerequisite: ENGL 134, junior standing or consent of instructor.

LIB 402 Library Resources and Literature Searches (1–4)
Sources of information and search strategies in major subject fields. Reference materials, bibliographic aids, indexing and abstracting tools, and Internet sources. Evaluation of sources. Class Schedule will list major subject area covered. Total credit limited to 12 units. 1-4 lectures. Prerequisite: ENGL 134, junior standing or consent of instructor.

LIB 502 Library Resources and Literature Searches (1–4)
Courses of information and search strategies in major subject fields. Reference materials, bibliographic aids, indexing and abstracting tools, and Internet sources. Evaluation of sources. Literature review process for a master's thesis. Class Schedule will list major subject area covered. Total credit limited to 12 units. 1-4 lectures. Prerequisite: Graduate standing.

LS–LIBERAL STUDIES

LS 101 Orientation to Liberal Studies (1)
Exploration of the Liberal Studies Program as preparation for the Multiple Subjects Credential and for alternate career objectives. To be taken during the first quarter in attendance at Cal Poly as a Liberal Studies major. 1 lecture.

LS 211 The American Enterprise: The Birth of a Nation to the 1876 Centennial (4)

LS 212 The American Enterprise: The 1876 Centennial to the 21st Century (4)
Manifest Destiny. Evolution of our government institutions–parallels between the past and present. Immigration in the 20th Century. The Nation steps into a larger world–World Wars. Civil Rights–equity for all. 3 lectures, 1 activity. Prerequisite: ENGL 134.

LS 230 Field Experience I (2)
Overview of current practices and issues in elementary education, including teacher compensation, cultural impact on schools, time and classroom management, English learners, and the affective aspect of teaching. 48 hours of fieldwork required. 1 lecture, 1 activity.

LS 250 Field Experience II (2)
Overview of current practices and issues in elementary education, including components of effective teaching, motivating students, diagnostic/prescriptive teaching, curriculum, and accountability. In
addition to class time, forty-eight hours of fieldwork required. 1 lecture, 1 activity.

LS 270 Introduction to Visual and Performing Arts Standards in the Elementary Classroom (4)
Introduction to the visual arts, music, dance and theatre. California visual and performing arts standards. Emphasis of aesthetic perception, creative expression, historical/cultural context, aesthetic valuing and application to the elementary classroom. 4 lectures.

LS 310 Storytelling: The Oral Tradition (4)
Techniques for performing traditional folktales and myths in primary and secondary teaching situations. Selection, preparation and presentation of folklore for an audience; lectures on function of folk literature and mythology in modern society. 4 lectures. Prerequisite: SCOM 101 or SCOM 102.

LS 311 Visual Arts in the Elementary Classroom (4)
Theory and philosophy of visual arts, through multi-strategies, as related to child development and visual arts processes for the elementary classroom. 4 lectures. Prerequisite: LS 101 or consent of instructor.

LS 312 Advanced Visual Arts in the Elementary Classroom (4)
Application of visual arts, through multi-strategies including direct classroom application, as related to child development and visual arts processes for the elementary setting. 4 lectures. Prerequisite: LS 311.

LS 400 Special Problems for Advanced Undergraduates (1–2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: consent of instructor, junior standing.

LS 461 Senior Project Seminar (4)
Examination of issues in education of state, national and international concern. Students prepare presentations and conduct individual research and analysis of selected problems. Substantial research paper required. 4 seminars. Prerequisite: Senior standing, completion of GWR or consent of instructor.

MATE–MATERIALS ENGINEERING

MATE 110 Introduction to Materials Engineering Design I (1)
Laboratory work in teams to design, build and test a product. Material from math, science and engineering courses tied together. 1 laboratory.

MATE 120 Introduction to Materials Engineering Design II (1)
Second design laboratory, working in teams on a project that benefits humanity. Issues of engineering ethics, technology and society, the environment and sustainability also studied. 1 laboratory.

MATE 200 Special Problems for Undergraduates (1–4)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 8 units, with a maximum of 4 units per quarter. Prerequisite: Consent of department head.

MATE 210 Materials Engineering (3)

MATE 215 Materials Engineering Laboratory (1)

MATE 220 Structure of Materials (3)

MATE 225 Structure of Materials Laboratory (1)
Relationship of atomic bonding to material properties. Building of crystals with physical models and by computer. Characterization of materials by x-ray diffraction (XRD) for phase identification, crystal structure determination and lattice constant measurements. Microstructural analysis by qualitative and quantitative metallography. 1 laboratory. Prerequisite: MATE 210. Concurrent: MATE 220.

MATE 230 Physical Metallurgy (4)

MATE 235 Physical Metallurgy Laboratory (1)
Interpretation of microstructures in metals and alloys and laboratory methods for revealing and documenting such microstructures. Casting and heat treating of metals. 1 laboratory. Prerequisite: MATE 225; MATE 230 should be taken concurrently.

MATE 310 Polymers (4) Changes, effective Winter ’07. See Updates.
Molecular structures of polymers and polymer systems. Synthesis, processing techniques, properties and fabrication methods of polymeric materials. 4 lectures. Prerequisite: MATE 210.

MATE 320 Ceramics (4)
Development, utilization, and control of properties in ceramic materials (inorganic-nonmetallic solids). Structure of crystalline ceramics and of glasses. Mechanical, thermal, optical, magnetic, and electrical properties. Physical chemistry of ceramics. 4 lectures. Prerequisite: MATE 210, CHEM 305.

MATE 330 Composites (4) Changes, effective Spring ’07. See Updates.
Fundamentals of polymer-matrix, ceramic-fiber composites from materials engineering and applied mechanics viewpoints. Materials (matrices, fibers) and manufacturing methods treated in detail. Beginning applied mechanics of continuous and discontinuous fiber-reinforced composites covered including properties of an orthotropic lamina; behavior of laminated plates. 4 lectures. Prerequisite: MATE 210, MATE 350, CE 204 or consent of instructor.

MATE 340 Electronic Properties of Materials (4) Changes.(4)
Basic concepts in electron theory of solids (quantum mechanics, energy band theory, Fermi energy, distribution and density of states), electrical properties and conduction in metals, semiconductors, polymers, ceramics, and superconductors, magnetic phenomena and optical properties in materials with applications in recording media. 3 lectures, 1 laboratory. Prerequisite: MATE 210, PHYS 133. Change effective Fall 2006.

MATE 345 Electronic Properties of Materials Laboratory (1)
Exploration of electrical, optical and magnetic properties of materials. Optical absorption, electrical conductivity, ferromagnetism, superconductivity. 1 laboratory. Concurrent or prerequisite: MATE 340.

MATE 350 Mechanical Behavior of Materials (3) Changes, effective Winter ’07. See Updates.
Fundamental behavior, emphasis on the relationship between microstructure and mechanical properties. Continuum mechanics–stress, strain, elasticity, anelasticity, plasticity. Detailed treatment of the mechanical behavior of (1) crystalline materials (metals, ceramics)–dislocation dynamics, slip, strengthening mechanisms; (2) non-crystalline materials (polymers). 3 lectures. Prerequisites: MATE 210, CE 204; MATE 355 should be taken concurrently.

MATE 355 Mechanical Behavior of Materials Laboratory (2)
Additional meaning to major concepts in MATE 350. Mechanical properties of materials. Major concepts in stress, strain, elasticity, and plasticity in a range of engineering materials. Multiple session
MATE 210, CE 204. Concurrent: MATE 350.

MATE 359 Living in a World Material (4) (Also listed as HIST 359)
Evolution of materials (ceramics, metals, polymers, composites, semiconductors) in the context of history. Traces the link between historical and technological developments enabled by materials from the Stone Age to the Electronic Age. 4 lectures. Prerequisite: Completion of GE Area B, and junior standing.

MATE 360 Thermodynamics of Materials (4)
Mass and energy balances, thermochemistry of reactions, design of materials processes including evaluation of energy needs and input/output stream compositions. 3 lectures, 1 laboratory. Prerequisite: MATE 210, CHEM 305. Change effective Fall 2006.

MATE 370 Kinetics of Materials (4) Changes, effective Spring '07. See Updates.
Theories and applications of kinetics in materials: solid-state diffusion (steady-state and non-steady-state), nucleation and growth kinetics, solid state phase transformations. 4 lectures. Prerequisite: MATE 360. Concurrent: MATE 375.

MATE 375 Thermodynamics and Kinetics of Materials Laboratory (1)

MATE 400 Special Problems for Advanced Undergraduates (1–4)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 8 units, with a maximum of 4 units per quarter. Prerequisite: Consent of department head.

MATE 401 Materials Characterization (3)

MATE 406 Materials Characterization Laboratory (2)

MATE 425 Corrosion Engineering (4)
Forms of corrosion. Influences of environmental variables on corrosion. Methods of corrosion control. 3 lectures, 1 laboratory. Prerequisite: CHEM 125 or CHEM 128, MATE 210, MATE 215. Materials analysis and characterization course or Special topics course.

MATE 430 Microfabrication (3)
Silicon-based fabrication science and technology. Oxidation, diffusion, ion implantation, etching, chemical and physical vapor deposition, photolithography. 3 lectures. Prerequisite: MATE 210. Prerequisite or concurrent: MATE 360 or permission of instructor. Materials processing course.

MATE 435 Microfabrication Laboratory (2)
Basic processes involved in microfabrication; cleanroom protocol, oxidation, diffusion, photolithographic and etching processes, sputtering and evaporation, process development through experimentation, device testing. Each student will be part of a 4-6 person team that will fabricate a micro electronic device or integrated circuit. 2 laboratories. Prerequisite or concurrent: MATE 430, STAT 312 or equivalent. Materials processing course.

MATE 440 Welding Metallurgy and Joining of Advanced Materials (3)
Principles, primary variables, and microstructural changes associated with the joining process. Physics of energy transfer. Heat and mass balances in joining, thermodynamic and kinetic justification of solidification and near interface microstructures. Heterogeneous interfaces, adhesion, wetting. Relation between process selection, interface design, microstructure, and properties, weldability. 3 lectures. Prerequisite: MATE 210. Materials processing course.

MATE 445 Joining of Advanced Materials Laboratory (2)
Laboratory to accompany MATE 440. Illustration of principles, primary variables, and microstructural changes associated with the joining process. Physics of energy transfer. Heat and mass balances in joining, thermodynamic and kinetic justification of solidification and near interface microstructures. Heterogeneous interfaces, adhesion, wetting. Relation between process selection, interface design, microstructure, and properties, weldability. 2 laboratories. Prerequisite: MATE 210. Materials processing course.

MATE 446 Surface Chemistry of Materials (3) (Also listed as CHEM 446)
Surface energy, capillarity, solid and liquid interface. Adsorption, surface areas of solids, contact angles and wetting. Friction, lubrication and adhesion. Relationship of surface to bulk properties of materials. Applications. 3 lectures. Prerequisite: CHEM 306 or consent of instructor. Special topics course.

MATE 450 Failure Analysis (3)

MATE 460 Materials Selection in Mechanical Design (4)
Materials-based approach to mechanical design. Using mechanical and physical properties of materials (performance indices) to select them for design needs (Materials Selection Charts). Detailed background of material properties – information from materials and mechanics. Numerous case studies highlight the concepts covered. 4 lectures. Prerequisite: MATE 210, CE 204, or consent of instructor. Special topics course.

MATE 481 Corporate Culture (1)
Practical working knowledge of key corporate topics such as leadership, ethics, organizational structure, intellectual property, professional communications, life-long learning, global and social impacts of technology. The product development process. 1 activity. Prerequisite: Senior standing. Co-requisite: MATE 482 for MATE majors.

MATE 482 Senior Project Design I (1)
Foundations of senior project design. Completion of the preliminary stages of selecting a senior project, designing experiments, evaluating realistic constraints, conducting initial experiments, and managing a project timeline. 1 lecture. Prerequisite: Senior standing. Co-requisite: MATE 481 for MATE majors.

MATE 483 Senior Project II (2)
Continuation of senior project. Completion of a senior project experimental component under the guidance of a faculty supervisor. Research methodology, experimental design, experimental work and data analysis. 1 lecture and supervised work. Prerequisite: MATE 482.

MATE 484 Senior Project III (2)
Continuation of MATE 483. Completion of a senior project data analysis and communication under the guidance of a faculty supervisor. Mathematical modeling and technical communication. 1 lecture and supervised work. Prerequisite: MATE 483.
MATE 493 Cooperative Education Experience (2) (CR/NC)
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. Total credit limited to 6 units. Prerequisite: Sophomore standing and consent of instructor.

MATE 494 Cooperative Education Experience (6) (CR/NC)
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. Total credit limited to 18 units. Prerequisite: Sophomore standing and consent of instructor.

MATE 495 Cooperative Education Experience (12) (CR/NC)
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. A more fully developed formal report and evaluation by work supervisor required. Credit/No Credit grading only. Total credit limited to 24 units. Prerequisite: Sophomore standing and consent of instructor.

MATE 500 Individual Study (1–4)
Advanced study planned and completed under the direction of a member of department faculty. Open only to graduate students who have demonstrated ability to do independent work. Enrollment by petition. Total credit limited to 12 units. Prerequisite: Consent of department head, graduate advisor, or supervising faculty member.

MATE 504 Research and Development in Materials Engineering (4)
Overview of the materials science and engineering field. Current materials research and technologies, such as fuel cells, nanotechnology, etc. Emphasis on independent learning, individual research topics, and presentations. Analysis of information from different media used to comprehend how advancements in materials research and development are made. Class Schedule will list topic selected. Total credit limited to 8 units. 4 lectures. Prerequisite: MATE 210 and graduate standing or consent of instructor.

MATE 520 X-Ray Diffraction (3)
Theory and application of x-ray diffraction as applied to advanced materials problems such as crystal quality and identification, thin film applications and structural transformations at high and low temperatures. Course will cover techniques in sample preparation, operation of equipment and interpretation of diffraction data. 3 lectures. Prerequisite: Graduate status or instructor’s permission. Materials analysis and characterization or Special topics course.

MATE 522 Advanced Ceramics (5)
Development, utilization, and control of properties in ceramic materials (inorganic-nonmetallic solids). Emphasis on application on processing to achieve structure and properties. Structure of crystalline ceramics and of glasses. Mechanical, thermal, optical, magnetic, and electrical properties. Application of ceramics in technology. Physical chemistry of ceramics. 4 lectures, 1 seminar. Prerequisite: Graduate standing or permission of instructor.

MATE 525 X-Ray Diffraction Laboratory (2)
X-ray diffraction laboratory experiments of advanced materials problems such as crystal quality and identification, thin film applications and structural transformations at high and low temperatures. Radiation safety training, techniques in sample preparation, operation of equipment and interpretation of diffraction data. 2 laboratories. Prerequisite: Graduate standing in engineering or science or instructor’s permission. Concurrent: MATE 520. Materials analysis and characterization or Special topics course.

MATE 530 Biomaterials (4)
Structures of biological materials - plant/animal. Biomechanics. Structure-function relationships for materials in contact with biological systems. Interactions of materials implanted in the body. Histological and hematological considerations including foreign body responses, inflammation, carcinogenicity, thrombosis, hemolysis, immunogenic and toxic properties. Microbial interaction with material surfaces, degradation. 4 lectures. Prerequisite: ENGR 213, MATE 210 and graduate standing or permission of instructor. Special topics course.

MATE 540 Tribology (3)

MATE 545 Tribology Laboratory (1)
Wear testing and measurement through various processes including dry sand rubber wheel, cavitation/erosion, and simulated chemical/mechanical polishing. Wear analysis to include wear modeling, materials characterization via metallography, scanning electron microscopy, and surface profilometry. Experiments focus on real engineering systems and their degradation as a result of wear. 1 laboratory. Prerequisite: MATE 210, MATE 215, MATE 230 or consent of instructor. Co-requisite: MATE 540.

MATE 550 Numerical Methods for Materials Engineers (4)
Numerical analysis techniques relevant to materials engineers. Topics include computer programming, data analysis and reduction methods, linear and non-linear regression; materials modeling methods such as finite differences; and finite elements. 3 lectures, 1 laboratory. Prerequisite: CSC 231/234, MATH 244, MATE 350, MATE 360 or consent of instructor. Materials analysis and characterization or Special topics course.

MATE 560 Thin-Film Processing (3)
Thin film science and technology: deposition techniques, surface crystal notation, energy and kinetic processes, epitaxy. Schottky barriers and surface states, stress analysis, characterization techniques, electronics devices incorporating thin films. Class Schedule will list topics for selection. Total credit limited to 6 units. 3 lectures. Prerequisite: Graduate standing or permission of instructor. Materials processing course.

MATE 565 Thin-Film Processing Laboratory (2)
Thin film processing and analytical techniques: direct current and radio frequency magnetron sputtering, reactive sputtering, co-evaporation, epitaxy, grazing incidence x-ray diffraction, magnetic force imaging. Class Schedule will list topics for selection. Total credit limited to 6 units. 2 laboratories. Concurrent: MATE 560 or consent of instructor. Materials processing course.

MATE 570 Advanced Engineering Materials (4)
An advanced treatment of the structure of matter. Physical and mechanical properties of materials including metals, alloys, ceramics, insulating materials, semiconductors, super semiconductors, polymers and composites based on detailed theoretical understanding of material microstructures. Discussions of Equilibrium diagrams, processing approaches, material selection based on thermodynamic and kinetic arguments. Degradation and failure, fitness for purpose. 4 lectures. Prerequisite: Graduate standing or permission of instructor. Special topics course.

MATE 580 Fracture and Fracture Mechanics of Materials (4)
Fracture modes and mechanisms in engineering materials, fracture mechanics fundamentals (stress analysis of cracks, energy analysis of fracture process). Use of fracture mechanics in design. Laboratory gives concentrated exposure to fracture development in materials, fracture surface evaluation, fracture toughness testing. 3 lectures, 1 laboratory. Prerequisite: MATE 350, MATE 355, or graduate standing. Special topics course.

MATE 590 Solidification and Densification (4)
MATE 599 Design Project (Thesis) (2) (2) (5)
Each individual or group will be assigned a project for solution under faculty supervision as a requirement for the master's degree, culminating in a written report/thesis. Prerequisite: Graduate standing.

MATH–MATHEMATICS

Satisfactory completion of the Entry Level Mathematics (ELM) requirement is a prerequisite for enrollment in all mathematics courses except MATH 100 and MATH 104. For additional mathematics placement information, see page 61.

MATH 100 Beginning Algebra Review (3) (CR/NC)
Review of basic algebra skills at the beginning algebra level intended primarily to prepare students for MATH 104. Course open only to students who have taken the ELM examination and are not qualified for MATH 104. Not for baccalaureate credit. Credit/No Credit grading only. 3 lectures.

MATH 104 Intermediate Algebra (3) (CR/NC)
Review of basic algebra skills at the intermediate algebra level intended primarily to prepare students for MATH 116. Not for baccalaureate credit. Credit/No Credit grading only. 3 lectures. Prerequisite: MATH 100 or equivalent.

MATH 110 Beginning Algebra Laboratory (1) (CR/NC)
Facilitated study and discussion of the theory, problems, and applications of beginning algebra. Not for baccalaureate credit. Credit/No Credit grading only. 1 laboratory. Corequisite: Concurrent enrollment in the associated section of MATH 110.

MATH 112 The Nature of Modern Mathematics (4) GE B1
Topics from contemporary mathematics, their development, applications, and role in society. Some typical topics, to be chosen by the instructor: graph theory, critical path analysis, statistical inference, coding, game theory, and symmetry. 4 lectures. Prerequisite: Passing score on ELM examination or an ELM exemption or credit in MATH 104.

MATH 114 Intermediate Algebra Laboratory (1) (CR/NC)
Facilitated study and discussion of the theory, problems, and applications of intermediate algebra. Not for baccalaureate credit. Credit/No Credit grading only. 1 laboratory. Corequisite: Concurrent enrollment in the associated section of MATH 114.

MATH 116, 117 Pre-Calculus Algebra I, II (3) (3)
For MATH 116 and 117: GE B1
Pre-calculus college algebra without trigonometry. Special products and factoring, exponents and radicals. Fractional and polynomial equations. Matrices, determinants, and systems of equations. Polynomial, rational, exponential, and logarithmic functions. Graphing, inequalities, absolute value, and complex numbers. MATH 116 and MATH 117 are equivalent to MATH 118, but are taught at a slower pace. Upon completion of MATH 116 and MATH 117, a student will receive 4 units of GE credit. Credit/No Credit grading only. 3 lectures. Prerequisite: Passing score on ELM examination or an ELM exemption or credit in MATH 104. MATH 117 prerequisite: MATH 116 with a grade of C- or better or consent of instructor.

MATH 118 Pre-Calculus Algebra (4) GE B1
Pre-calculus algebra without trigonometry. Special products and factoring, exponents and radicals. Fractional and polynomial equations. Matrices, determinants, and systems of equations. Polynomial, rational, exponential, and logarithmic functions. Graphing, inequalities, absolute value, and complex numbers. MATH 118 is equivalent to MATH 116 and MATH 117. Not open to students with credit in MATH 116 and MATH 117. Credit/No Credit grading only. 3 lectures. Prerequisite: Completion of ELM requirement and passing score on appropriate Mathematics Placement examination.

MATH 119 Pre-Calculus Trigonometry (4) GE B1
Rectangular and polar coordinates. Trigonometric functions, fundamental identities. Inverse trigonometric functions and relations. Vectors, complex numbers, conic sections, and analytic geometry. 4 lectures. Prerequisite: Completion of ELM requirement and passing score on appropriate Mathematics Placement Examination, or MATH 117, or MATH 118 or equivalent.

MATH 126 Pre-Calculus Algebra I Laboratory (1) (CR/NC)
Facilitated study and discussion of the theory, problems, and applications of pre-calculus algebra. Credit/No Credit grading only. 1 laboratory. Corequisite: Concurrent enrollment in the associated section of MATH 116.

MATH 127 Pre-Calculus Algebra II Laboratory (1) (CR/NC)
Facilitated study and discussion of the theory, problems, and applications of pre-calculus algebra. Credit/No Credit grading only. 1 laboratory. Corequisite: Concurrent enrollment in the associated section of MATH 117.

MATH 128 Pre-Calculus Algebra Laboratory (1) (CR/NC)
Facilitated study and discussion of the theory, problems, and applications of pre-calculus algebra. Credit/No Credit grading only. 1 laboratory. Corequisite: Concurrent enrollment in the associated section of MATH 118.

MATH 141, 142, 143 Calculus I, II, III (4) (4) (4) GE B1
Limits, continuity, differentiation, integration. Techniques of integration, applications to physics, transcendental functions. Infinite sequences and series, vector algebra, curves. 4 lectures. MATH 141 prerequisite: Completion of ELM requirement and passing score on appropriate Mathematics Placement Examination, or MATH 118 and MATH 119 or equivalent. MATH 142 prerequisite: MATH 141 with a grade of C- or better or consent of instructor. MATH 143 prerequisite: MATH 142.

MATH 151, 152, 153 Calculus Laboratories I, II, III (4) (4) (4) (5)
Differential and integral calculus with applications to the biological sciences. Introduction to differential equations and mathematical modeling. Examples, exercises and applications to emphasize problems in life sciences. Not open to students with credit in MATH 141, 142 respectively. 4 lectures. Prerequisite: Completion of ELM requirement and passing score on appropriate Mathematics Placement Examination, or MATH 118 or equivalent.

MATH 157  Calculus for Architecture and Construction Management (4)
Integral calculus with applications to architecture and construction management. The algebra of vectors. Polar, cylindrical, and spherical coordinate systems. Not open to students with credit in MATH 142. 4 lectures. Prerequisite: MATH 141 or equivalent.

MATH 158  Calculus for Architecture and Construction Management Laboratory (1) (CR/NC)
Facilitated study and discussion of the theory, problems, and applications of calculus. Credit/No Credit grading only. 1 laboratory. Corequisite: Concurrent enrollment in the associated section of MATH 157.

MATH 161, 162 Calculus for the Life Sciences I, II (4) (4) GE B1
Review of exponential, logarithmic, and trigonometric functions. Differential and integral calculus with applications to the biological sciences. MATH 161 prerequisite: MATH 141 or equivalent.

MATH 182 Calculus for Architecture and Construction Management (4) GE B1
Integral calculus with applications to architecture and construction management. The algebra of vectors. Polar, cylindrical, and spherical coordinate systems. Not open to students with credit in MATH 142. 4 lectures. Prerequisite: MATH 141 or equivalent.

MATH 192 Calculus for Architecture and Construction Management Laboratory (1) (CR/NC)
Facilitated study and discussion of the theory, problems, and applications of calculus to architecture and construction management. Credit/No Credit grading only. 1 laboratory. Corequisite: Concurrent enrollment in the associated section of MATH 182.

1 Each course in a combined listing of sequentially numbered courses is a prerequisite to its successor in the same listing.
MATH 202 Orientation to the Mathematics Major (1) (CR/NC)
Career opportunities in the field of mathematics, preparing a field of study, and a survey of departmental facilities and procedures related to research, study and graduation. Credit/No Credit grading only. 1 lecture. Corequisite: Sophomore standing or consent of instructor.

MATH 206 Linear Algebra I (4)
Matrices, inverses, linear systems, determinants, eigenvalues, eigenvectors, vector spaces, linear transformations, applications. 4 lectures. Prerequisite: MATH 143 or consent of instructor.

MATH 211, 212 Computational Mathematics I, II (4) (4)
Fundamentals of procedural programming in C/C++ and selected applications to problems in integral and differential calculus, matrix analysis, geometry, and physics. 4 lectures. Prerequisite: MATH 141 or consent of instructor.

MATH 221 Calculus for Business and Economics (4) GE B1
Polynomial calculus for optimization and marginal analysis, and elementary integration. Not open to students with credit in MATH 142. 4 lectures. Prerequisite: Completion of ELM requirement and passing score on appropriate Mathematics Placement Examination, or MATH 118 or equivalent.

MATH 231 Calculus for Business and Economics Laboratory (1) (CR/NC)
Facilitated study and discussion of the theory, problems, and applications of business calculus. Credit/No Credit grading only. 1 laboratory. Corequisite: Concurrent enrollment in the associated section of MATH 221.

MATH 241 Calculus IV (4) (Also listed as HNRS 241) GE B1
Partial derivatives, multiple integrals, introduction to vector analysis. 4 lectures. Prerequisite: MATH 143.

MATH 242 Differential Equations (4)
Ordinary differential equations: introduction with selected applications; classification of equations and their analytic solutions; study of interrelationships between differential equations, graphs, and physical problems. Systems of ordinary differential equations. Not open to CENG students. 4 lectures. Prerequisite: MATH 206 or MATH 241.

MATH 244 Linear Analysis I (4) (Also listed as HNRS 244)
Separable and linear ordinary differential equations with selected applications; numerical and analytical solutions. Linear algebra: vectors in n-space, matrices, linear transformations, eigenvalues, eigenvectors, diagonalization; applications to the study of systems of linear differential equations. 4 lectures. Prerequisite: MATH 143 or consent of instructor.

MATH 248 Methods of Proof in Mathematics (4)
Methods of proof (direct, contradiction, conditional, contraposition); valid and invalid arguments. Examples from set theory. Quantified statements and their negations. Functions, indexed sets, set functions. Proofs in number theory, algebra, geometry and analysis. Proof by induction. Equivalence and well-defined operations and functions. The axiomatic method. 4 lectures. Prerequisite: MATH 143 or consent of instructor.

MATH 258 Methods of Proof in Mathematics Laboratory (1) (CR/NC)
Facilitated study and discussion of the methods and techniques of proof in mathematics. Credit/No Credit grading only. 1 laboratory. Corequisite: Concurrent enrollment in the associated section of MATH 248.

MATH 300 Technology in Mathematics Education (4)
Examination of existing hardware and software designed for educational uses. Discussion of mathematical topics appropriate for computer enhancement. Special methods and techniques for educational uses of computers. Emphasis on activity learning and applications. Computer as a classroom management device. 4 lectures. Prerequisite: MATH 141 or MATH 329, and a course in CSC or MATH 211, or consent of instructor.

MATH 304 Vector Analysis (4) GE B6
Algebra of free vectors with applications. Differential and integral calculus of vectors. Development of theory and application of vector operations. Green’s Theorem, Stokes’ Theorem, and the Divergence Theorem. 4 lectures. Prerequisite: MATH 206 or MATH 244, and MATH 241, or consent of instructor.

MATH 306 Linear Algebra II (4)
Inner product spaces, orthogonality, Fourier series and orthogonal bases, linear transformations and similarity, eigenvalues and diagonalization. 4 lectures. Prerequisite: MATH 206 and MATH 242, or MATH 241 and MATH 244, and a C- or better in MATH 248, or consent of instructor.

MATH 326 Mathematics and Visual Art (4) GE B5
Topics connecting mathematics and visual art including regular polygons, symmetry groups, repetition and pattern, perspective, straightedge and compass constructions, and origami. Examples of mathematical art including historic and contemporary art. 4 lectures. Prerequisite: Completion of GE Area B1 and a college course in art or design.

MATH 327, 328, 329 Mathematics for Elementary Teaching I, II, III (4) (4)
Introduction to set theory, number theory, real numbers, probability, statistics, and geometry. Computer applications. 2 lectures, 2 activities.

MATH 327 prerequisite: Completion of ELM requirement, and passing score on appropriate Mathematics Placement Examination, or MATH 118 or equivalent.

MATH 331 Topics in Mathematics for Teachers (1-6) (CR/NC)
Topics in mathematics for practicing credentialed teachers. Content will vary according to teaching level. Class Schedule will list topic selected. Total credit limited to 12 units. Credit/No Credit grading only. 1-6 activities. Prerequisite: Multiple Subject or Single Subject teaching credential or consent of instructor.

MATH 333 Numerical Analysis I (4)
Topics in interpolation and approximation methods, initial value problems, and boundary value problems of ordinary differential equations. 4 lectures. Prerequisite: MATH 206 and MATH 242, or MATH 241 and MATH 244, or consent of instructor.

MATH 335 Graph Theory (4)
Introduction to graph theory and its applications: isomorphism, paths and searching, connectedness, trees, tournaments, planarity, graph colorings, matching theory, network flow, adjacency and incidence matrices. Further topics to be selected from the theory of finite state machines, Ramsey theory, extremal theory, and graphical enumeration. 4 lectures. Prerequisite: Junior standing or consent of instructor.

MATH 336 Combinatorial Mathematics (4)
Methods of enumerative combinatorics: sum, product, and division rules, bijective and recursive techniques, inclusion and exclusion, generating functions, and the finite difference calculus. Advanced topics to be selected from the theory of partitions, Polya theory, designs, and codes. 4 lectures. Prerequisite: Junior standing or consent of instructor.

MATH 341 Theory of Numbers (4)
Properties of numbers. Euclid’s Algorithm, greatest common divisors, diophantine equations, prime numbers, congruences, number theoretic functions, the quadratic reciprocity laws, primitive roots and indices. 4 lectures. Prerequisite: MATH 248 with a grade of C- or better or consent of instructor.

MATH 344 Linear Analysis II (4) GE B6
Linear methods applied to the solution of differential equations. Laplace transforms. Series solutions to ordinary differential equations. Orthogonality in n-space, Gram-Schmidt orthogonalization and least squares methods. Orthogonal bases in function spaces, Sturm-Liouville theory. Fourier series and transforms. Special functions of applied mathematics. 4 lectures. Prerequisite: MATH 206 and MATH 242, or MATH 241 and MATH 244, or consent of instructor.

1 Each course in a combined listing of sequentially numbered courses is a prerequisite to its successor in the same listing.

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MATH 350 Mathematical Software (4)  
Problem-solving using mathematical software. 4 lectures. Prerequisite: CSC/CPE 101 or CSC/CPE 235, and MATH 206 or MATH 244, and MATH 241, or consent of instructor.

MATH 370 Putnam Exam Seminar (2)  
Directed group study of mathematical problem solving techniques. Open to undergraduate students only. Class members are expected to participate in the annual William Lowell Putnam Mathematical Competition. Course may be repeated up to eight units. 2 seminars. Prerequisite: Consent of instructor.

MATH 371 Math Modeling Seminar (2)  
Directed group study of mathematical modeling techniques. Open to undergraduate students only. Class members are expected to participate in the annual Mathematical Competition in Modeling. Total credit limited to 8 units. 2 seminars. Prerequisite: Consent of instructor.

MATH 372 Mathematical Community Service Projects (2) (CR/NC)  
Directed group mathematical research in support of volunteer community service projects. Total credit limited to 8 units. 2 seminars. Prerequisite: consent of instructor and consent of department chair.

MATH 400 Special Problems for Advanced Undergraduates (1-4)  
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 8 units. Prerequisite: Junior standing and consent of department chair.

MATH 404 Introduction to Differential Geometry and Topology (4)  
Theory of curves and surfaces in space. Topics such as curvature, geodesics, Gauss map, Gauss-Bonnet Theorem, combinatorial topology, point set topology, conformal mappings. 4 lectures. Prerequisite: MATH 304 or consent of instructor.

MATH 406 Linear Algebra III (4)  
Complex vector spaces, unitary and self-adjoint matrices, Spectral Theorem, Jordan canonical form. Selected topics in linear programming, convexity, numerical methods, and functional analysis. 4 lectures. Prerequisite: MATH 306 or consent of instructor.

1 MATH 408, 409 Complex Analysis I, II (4) (4)  
MATH 408: GE B6  
Elementary analytic functions and mappings. Cauchy’s Integral Theorem; Poisson’s Integral Formula. Taylor and Laurent series, theory of residues, convolution integrals, Harmonic functions, conformal mappings. 4 lectures. Prerequisite: MATH 242, or MATH 241 and MATH 244, or consent of instructor.

MATH 412 Introduction to Analysis I (4)  
Introduction to concepts and methods basic to real analysis. Topics such as the real number system, sequences, continuity, uniform continuity and differentiation. 4 lectures. Prerequisite: MATH 306 or consent of instructor.

1 MATH 413, 414 Introduction to Analysis II, III (4) (4)  
A continuation of Introduction to Analysis I covering such topics as integration, infinite series, uniform convergence and functions of several variables. Highly recommended for students planning to enter graduate programs or secondary teaching and those interested in applied mathematics. 4 lectures. Prerequisite: MATH 412 or consent of instructor.

MATH 417 Introduction to Dynamical Systems (4)  
Theory of dynamical systems in one and two dimensions. Topics such as bifurcation theory, chaos, attractors, limit cycles, nonlinear dynamics. 4 lectures. Prerequisite: MATH 206 and MATH 242, or MATH 241 and MATH 244, or consent of instructor.

MATH 418 Partial Differential Equations (4)  

MATH 419 Introduction to the History of Mathematics (4)  
Evolution of mathematics from earliest to modern times. Major trends in mathematical thought, the interplay of mathematical and technological innovations, and the contributions of great mathematicians. Appropriate for prospective and in-service teachers. 4 lectures. Prerequisite: MATH 248 with a grade of C- or better and at least one upper division course in mathematics, or consent of instructor.

MATH 422 Introduction to Analysis I Laboratory (1) (CR/NC)  
Facilitated study and discussion of the methods and techniques of proof in introductory analysis. Credit/No Credit grading only. 1 laboratory. Corequisite: Concurrent enrollment in the associated section of MATH 412.

MATH 423 Advanced Mathematics for Teaching (4)  
Introduction to mathematics education research and advanced exploration of the rational number system, real number system, complex number system, functions, equations, distance and similarity, trigonometry, area and volume, and the Cartesian model for Euclidean geometry. 4 lectures. Prerequisite: MATH 442 and MATH 481.

MATH 424 Organizing and Teaching Mathematics (4)  
Organization, selection, presentation, application and interpretation of subject matter in mathematics. Introduction to current issues in mathematics education. For students who will be teaching in secondary schools. 4 lectures. Prerequisite: Senior standing or consent of instructor.

1 MATH 431, 432 Mathematical Optimization I, II (4) (4)  
Classical optimization. Maximum/minimum of functions, linear and nonlinear optimization problems, duality, constrained optimization. Model building and applications to various fields. 4 lectures. Prerequisite: MATH 206 or MATH 244, and MATH 241, or consent of instructor.

MATH 433 Numerical Analysis II (4)  
Numerical techniques for solving partial differential equations of the parabolic, hyperbolic and elliptic type. Further topics in approximation theory. 4 lectures. Prerequisite: MATH 333 or equivalent.

MATH 437 Game Theory (4)  
Development of the mathematical concepts, techniques, and models used to investigate optimal strategies in competitive situations; games in extensive, normal, and characteristic form, Nash equilibrium points and Nash Bargaining Model. 4 lectures. Prerequisite: MATH 206 or MATH 244, and MATH 248 with a grade of C- or better, or consent of instructor.

MATH 440 Topology I (4)  
Introduction to general topological spaces with emphasis on surfaces and manifolds. Open and closed sets, continuity, compactness, connectedness, Quotient spaces. 4 lectures. Prerequisite: MATH 412 and concurrent enrollment in or completion of MATH 481, or consent of instructor.

MATH 441 Topology II (4)  
Introduction to general topological spaces with emphasis on surfaces and manifolds. Fundamental group. Triangulations of spaces, classification of surfaces. Other topics may include covering spaces, simplicial homology, homotopy theory and topics from differential topology. 4 lectures. Prerequisite: MATH 440 or consent of instructor. Recommended: MATH 304.

MATH 442 Euclidean Geometry (4)  
Foundations of Euclidean geometry, finite geometries, congruence, similarities, polygonal regions, circles and spheres. Constructions, mensuration, the parallel postulate. Appropriate for prospective and in-service mathematics teachers. 4 lectures. Prerequisite: MATH 248 with a grade of C- or better or consent of instructor. Recommended: MATH 300 or familiarity with dynamic geometry software.

MATH 443 Modern Geometries (4)  
Non-Euclidean and projective geometries. Properties of parallels, triangles, Saccheri and Lambert quadrilaterals, angle-sum and area. Limiting curves,
MATH 459 Senior Seminar (4)
Written and oral analyses and presentations by students on topics from advanced mathematics and mathematical modeling. 4 seminars. Prerequisite: MATH 306, and completion of at least two additional upper-division courses in the math major, or consent of instructor.

MATH 461, 462 Senior Project I, II (2) (2)
Selection and completion of a project under faculty supervision. Projects typical of problems which graduates must solve in their fields of employment. Project results are presented in a formal report. Minimum 120 hours total time. Prerequisite: MATH 459.

MATH 470 Selected Advanced Topics (1-4)
Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 8 units. 1 to 4 lectures. Prerequisite: Junior standing and consent of instructor.

MATH 481, 482 Abstract Algebra I, II (4) (4)
Fundamental algebraic structures and types of algebras, including operations within them and relations among them. Groups, rings and fields. 4 lectures. Prerequisite: MATH 306 or MATH 341 or consent of instructor.

MATH 485 Cooperative Education Experience (6) (CR/NC)
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Junior standing and consent of instructor.

MATH 491 Abstract Algebra I Laboratory (1) (CR/NC)
Facilitated study and discussion of the methods and techniques of proof in abstract algebra. Credit/No Credit grading only. 1 laboratory. Corequisite: Concurrent enrollment in the associated section of MATH 481.

MATH 495 Cooperative Education Experience (12) (CR/NC)
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

MATH 500 Individual Study (1-4)
Individual research or advanced study planned and completed under the direction of a departmental faculty member. Open only to graduate students demonstrating ability to do independent work. Prerequisite: Graduate standing and consent of department chair.

MATH 501, 502 Methods of Applied Mathematics I, II (4) (4)
Introduction to advanced methods of mathematics useful in the analysis of engineering problems. Theory of vector fields, Fourier analysis, Sturm-Liouville theory, functions of a complex variable. Selected topics in asymptotic analysis, special functions, perturbation theory. Not open to students in major or master’s degree program in mathematics. MATH 501: Distance Learning Lab fee may be required—see Class Schedule. 4 lectures. Prerequisite: MATH 344 or AERO 300 or equivalent, and graduate standing, or consent of instructor.

MATH 510 Survey of Modern Mathematics (4)
Selected topics from the field of modern mathematics. Projective and synthetic geometry, topology, logic, matrices, vectors. Theory of games, probability, linear and modern algebra and convex sets. Boolean algebras, graph theory, lattice theory, geometry of complex numbers. 4 seminars. Prerequisite: Graduate standing or consent of instructor.

MATH 520, 521 Applied Analysis I, II (4) (4)
Advanced mathematical methods of analysis in science and engineering, integrated with modeling of physical phenomena. Topics include applications of complex analysis, Fourier analysis, ordinary and partial differential equations. Additional topics to be drawn from perturbation methods, asymptotic analysis, dynamical systems, numerical methods, optimization, and the calculus of variations. 4 lectures. Prerequisite: MATH 408, MATH 412 and graduate standing, or consent of the instructor. Recommended: MATH 418.

MATH 530, 531 Discrete Mathematics with Applications I, II (4) (4)
Advanced mathematical methods of discrete mathematics with applications. Topics will include probability theory with generating functions, difference equations and number theory. Additional topics to be drawn from the theory of algorithms, coding theory, set theory, and the relation of discrete mathematics to complex analysis. 4 lectures. Prerequisite: MATH 481, MATH 306 and graduate standing, or consent of instructor.

MATH 540 Topology I (4)
Introduction to general topological spaces with emphasis on surfaces and manifolds. Open and closed sets, continuity, compactness, connectedness, Quotient spaces. 4 lectures. Not open to students with credit in MATH 440. Prerequisite: MATH 412, concurrent enrollment in or completion of MATH 481, and graduate standing, or consent of instructor.

MATH 541 Topology II (4)
Introduction to general topological spaces with emphasis on surfaces and manifolds. Fundamental group. Triangulations of spaces, classification of surfaces. Other topics may include covering spaces, simplicial homology, homotopy theory and topics from differential topology. 4 lectures. Not open to students with credit in MATH 441. Prerequisite: MATH 540 and graduate standing, or consent of instructor. Recommended: MATH 304.

MATH 550 Real Analysis (4)
Introduction to Lebesgue measure and integration, convergence theorems, $L_1$ spaces, Radon-Nikodym Theorem and Fubini’s Theorem. 4 seminars. Prerequisite: Satisfactory completion of the Graduate Written Examination in Analysis or consent of the Graduate Committee.

MATH 559 Seminar (1-4)
Built around topics in advanced mathematics chosen according to the common interests and needs of the students enrolled. Each seminar will have a subtitle according to the nature of the content. Total credit limited to 12 units. 1–4 seminars. Prerequisite: Graduate standing and consent of instructor.

MATH 560 Seminar (1-4)
Serious research endeavor devoted to the development, pedagogy or learning of mathematics. Course to be taken twice for a total of 6 units. Prerequisite: Graduate standing and consent of instructor.

MCRO–MICROBIOLOGY

MCRO 221 Microbiology (4) GE B2 & B4
Morphology, metabolism, classification, and identification; microbiology of air, soil, water, and foods with applications to industry, agriculture, medicine, and public health. Not open to students with credit in MCRO 224; not for credit for Biology and Microbiology majors. 3 lectures, 1 laboratory. Prerequisite: One quarter of chemistry.
MCRO 224 General Microbiology I (5) GE B2 & B4
Microbial cellular structure and function, nutrition and growth dynamics, control of microbial growth, metabolism, genetics, and viruses. Both prokaryotic and eukaryotic microorganisms emphasized. 3 lectures, 2 laboratories. Prerequisite: BIO 161 and CHEM 128. Recommended: CHEM 129.

MCRO 225 General Microbiology II (5)
Microbial diversity, systematics, ecology, and symbiotic relationships. Introduction to host-microorganism interactions including pathogenesis, epidemiology, and immunology. 3 lectures, 2 laboratories. Prerequisite: MCRO 224 or consent of instructor.

MCRO 320 Emerging Infectious Diseases (3)
Recent outbreaks of human diseases, interrelationships between infectious disease agents, human biology, and the environment. Infectious agents and disease processes, surveillance methods to detect, investigate, and monitor emerging pathogens. Factors involved in the accelerating emergence of diseases and bioterrorist agents. 3 lectures. Prerequisite: MCRO 221 or MCRO 224 or BIO 161.

MCRO 342 Sanitary Microbiology (4)
Principles of disease prevention and control. Water-, food-, and air-borne microbial contaminations and epidemiology of ensuing diseases. 3 lectures, 1 laboratory. Prerequisite: MCRO 221 or MCRO 224.

MCRO 402 General Virology (4)
Infective macromolecules (prions, viroids, and viruses) associated with microbes, plants, and animals. Epidemiology, immune responses, pathogenicity, carcinogenesis, diagnoses, vaccination, and therapy. 3 lectures and 1 laboratory. Prerequisite: BIO 351 or CHEM 373. Recommended: BIO 452. Change effective Winter 2007.

MCRO 421 Food Microbiology (4)
Physiological activities of microorganisms involved in the preparation, preservation, deterioration, and toxicity of foods and related products. 2 lectures, 2 laboratories. Prerequisite: MCRO 221 or MCRO 224. Recommended: CHEM 212/312.

MCRO 423 Medical Microbiology (5)
Microorganisms as agents of disease in humans. Epidemiology, host-parasite relationships, and chemotherapy. The compromised host and opportunistic disease. Laboratory safety. Procedures for laboratory diagnosis of human diseases. Rapid miniaturized methods of identification. 3 lectures, 2 laboratories. Prerequisite: MCRO 225 and CHEM 312 or CHEM 316.

MCRO 424 Microbial Physiology (5)
Cellular structure and life processes of bacteria; chemical composition, growth, and metabolism. General biological and evolutionary considerations. 3 lectures, 2 laboratories. Prerequisite: MCRO 225 and CHEM 313 or CHEM 371.

MCRO 433 Microbial Biotechnology (3)
Principles and methods used for production of enzymes, pharmaceuticals, chemicals, and food additives using micro-organisms. Topics include screening and strain improvement, regulation of metabolic production, genetic engineering, heterologous gene expression systems, large-scale production, and intellectual property. 3 lectures. Prerequisite: MCRO 221 or MCRO 224, and BIO 303, BIO 351 or equivalent, and CHEM 312, CHEM 316 or equivalent.

MCRO 436 Microbial Diversity and Ecology (5) (4)
Ecology and interactions of prokaryotic and eukaryotic microorganisms in natural environments. Fundamentals of microbial ecology, microbial evolution, microbes and ecosystem function (bioremediation), practical aspects of microbial interactions, and microbial systematics. 3 lectures, 2 laboratories. 1 laboratory. Prerequisite: BIO 160 and BIO 161 or MCRO 221 or MCRO 224. Change effective Winter 2006.

MCRO 461 Senior Project (2)
Completion of a literature review and/or research proposal, including analysis of experimental results from published peer-reviewed articles covering issues in microbiology, culminating in both written and oral presentations. 2 activities. Prerequisite: Junior or senior standing or consent of instructor.

ME—MECHANICAL ENGINEERING

ME 134 Introduction to Mechanical Engineering (1)
Introduction to mechanical engineering and its application in professional practice. Includes design, analysis, testing and dissection of mechanical engineering systems, from simple machines to more complicated systems. 1 laboratory.

ME 151 Engineering Design Communication I (2)
Communication of designs to manufacturing using basic definitions of points, lines and planes in space. Pictorials, orthographic projection, section views and auxiliary views. Techniques from geometry, vectors, analysis, and spatial definitions integrated to provide information to both the design and manufacturing processes. 1 lecture, 1 laboratory.

ME 152 Engineering Design Communication II (2)
Use of advanced communication principles to communicate project designs to manufacturing processes. Projects evaluated in terms of meeting design criteria. Techniques of advanced communication including weld symbols, threaded fasteners, dimensioning and tolerancing. Use of computers to enhance these processes. 1 lecture, 1 laboratory. Prerequisite: ME 151.

ME 153 Introduction to Solid Modeling (1)
Introduction to solid modeling, using current software and hardware. Creation of part models and assembly models; working drawings produced from the models. Introduction to finite element analysis using the chosen software. Relevancy of solid modeling to design and manufacturing. 1 laboratory. Prerequisite: ME 152 or equivalent.

ME 211 Engineering Statics (3)
Analysis of forces on engineering structures in equilibrium. Properties of forces, moments, couples, and resultants. Equilibrium conditions, friction, centroids, area moments of inertia. Introduction to mathematical modeling and problem solving. Vector mathematics where appropriate. 3 lectures. Prerequisite: MATH 241 (or concurrently), PHYS 131.

ME 212 Engineering Dynamics (3)
Analysis of motions of particles and rigid bodies encountered in engineering. Velocity, acceleration, relative motion, work, energy, impulse, and momentum. Further development of mathematical modeling and problem solving. Vector mathematics where appropriate. 3 lectures. Prerequisite: MATH 241, ME 211.

ME 234 Philosophy of Design (3)
General approach to the meaning of engineering design. Conceptual blocks, creativity, design process, design considerations and elements. 3 lectures.

ME 236 Thermal Measurements (3)
Introduction to principles of experimental measurement, including practical instrument reading, data collection, and uncertainty analysis. Techniques for measuring temperature, pressure, and other parameters. Introduction to theory and practice of writing lab reports and communication of experimental data. 2 lectures, 1 laboratory. Prerequisite: CHEM 125, ENGL 134, PHYS 132.

ME 240 Additional Engineering Laboratory (1) (CR/NC)
Special assignments undertaken by students who need or wish to acquire abilities supplementary to their standard pattern of courses. Assignments must be primarily of shop or laboratory nature. Work is done by the student with a minimum of faculty supervision. Credit/No Credit grading only. 1 laboratory. Prerequisite: Consent of department head.

ME 302 Thermodynamics (3)
Properties of working fluids and fundamental relations for processes involving the transfer of energy. First and second laws of thermodynamics, irreversibility and availability. 3 lectures. Prerequisite: PHYS 132, ME 212.
ME 303  Thermal Engineering (3)
Vapor and gas power cycles, refrigeration cycles, thermodynamic relations, psychrometrics, and chemical reactions. 3 lectures. Prerequisite: ME 236, ME 302.

ME 305  Introduction to Mechatronics (4)
Introduction to microcontrollers and assembly language programming. Emphasis on components and techniques for interfacing that are typical of embedded microcontroller applications (A/D conversion, D/A conversion, interrupts, timers, and pulse-width modulation). Laboratory exercises involve real-time interfacing of microcontrollers to external mechanical and/or electromechanical devices. 3 lectures, 1 laboratory. Prerequisite: EE 321 and EE 361, or consent of instructor.

ME 318  Mechanical Vibrations (4)
Free and forced vibration response of single and multiple degree of freedom systems. Experimental studies of the dynamic behavior of structures and machines. Instrumentation methods utilized in field and laboratory. 3 lectures, 1 laboratory. Prerequisite: EE 321 or consent of instructor.

ME 321  Solar Energy (4)  GE Area F
Methods of utilizing solar energy. Energy concepts, collection and storage systems; greenhouse effect. Commercial and residential building applications. Solar power generation and recent technical developments. International achievements in solar energy with emphasis on solar energy application in developing countries for water purification and other life support functions. 4 lectures. Prerequisite: PHYS 131 or PHYS 123, completion of GE Area B and junior standing.

ME 326  Intermediate Dynamics (4)
Continuation of ME 212. Additional analysis of planar motion of rigid bodies with particular attention to the kinematics of mechanisms. Rotating reference frames. Introduction to three dimensional dynamics. Dynamic simulation of mechanisms. 4 lectures. Prerequisite: MATH 242 (or concurrent), ME 212, MATE 231 or MATE 234.

ME 328  Introduction to Design (4)
Design of machine parts by stress and deflection. Effects of fluctuating stresses and stress concentration. Design of shafts and other machine parts. Modern industrial design practice using standard components and design layout drawings. 3 lectures, 1 laboratory. Prerequisite: CE 207, ME 152, MATE 210, MATE 231 or MATE 234, ME 212.

ME 329  Intermediate Design (4)
Design of mechanical equipment and systems using various machine elements and components such as threaded fasteners, power screws, springs, gears, bearings, clutches, prime movers, etc. Decision modeling based on technical and economic feasibility. 3 lectures, 1 laboratory. Prerequisite: ECON 201, ME 318 (or concurrent), ME 328.

ME 341  Fluid Mechanics I (3)
Fluid statics. Conservation equations of fluid dynamics. Viscous flow, boundary layer concepts, lift and drag, compressible flow, turbomachinery. 3 lectures. Prerequisite: ME 212.

ME 343  Heat Transfer (4)
Basic principles of heat transfer. Conduction, convection, radiation, and combined modes. Optional thermal engineering design project. 4 lectures. Prerequisite: ME 341, ME 302 or CHEM 305, MATH 244, MATE 231 or MATE 234.

ME 346  Thermal Science Laboratory (1)
Heat transfer and thermodynamic experiments covering combined free convection and radiation, transient conduction, energy conversion, heat exchanger, polytropic blowdown, steam turbine, and refrigeration cycles. 1 laboratory. Prerequisite: ME 303, ME 341, ME 343.

ME 347  Fluid Mechanics II (4)
Conservation equations of fluid dynamics. Viscous flow, boundary layer concepts, lift and drag, compressible flow, turbomachinery. Laboratory measurement of turbomachine performance, velocity profiles, boundary layers on surfaces. 3 lectures, 1 laboratory. Prerequisite: ME 236, ME 341.

ME 359  Fundamentals of HVAC Systems (4)
Fundamentals of heating, ventilating and air-conditioning (HVAC) systems, human comfort and indoor air quality, primary and secondary systems and components. 3 lectures, 1 laboratory. Prerequisite: ME 302.

ME 400  Special Problems for Advanced Undergraduates (1–4)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of instructor. Change effective Summer 2005.

ME 401  Stress Analysis (4)
Advanced strength of materials: behavior of disks, plates, and shells. Theory of elasticity. Energy methods. 3 lectures, 1 laboratory. Prerequisite: CE 207, MATH 344, ME 328 or consent of instructor.

ME 402  Orthopedic Biomechanics (4)
Biomechanical analysis of the musculoskeletal system. Emphasis on the use of statics, dynamics, strength of materials, viscoelasticity, and poroelasticity to analyze the mechanical loads acting on human joints, the mechanical properties of tissues, and the design of artificial joints. 4 lectures 3 lectures, 1 laboratory. Prerequisite: ME 328 or consent of instructor. Change effective Winter 2006.

ME 404  Applied Finite Element Analysis (4)
Finite element based solutions to engineering problems with an emphasis on elastostatic problems in structural mechanics. The power and pitfalls associated with the finite element method highlighted through practical modeling assignments. Use of commercial finite element code(s). 3 lectures, 1 laboratory. Prerequisite: ME 329.

ME 405  Mechatronics (4)
Microprocessor applications in machine control and product design. Applied electronics. Drive technology; transducers and electromechanical systems. Real-time programming. Mechatronic design methodology. 3 lectures, 1 laboratory. Prerequisite: ME 305, ME 329.

ME 406  Mechatronics Design (4)
Application of micro-controllers and programmable logic controllers in the design of mechatronic products and automation systems. Digital feedback motion and process control. Modern industrial mechatronics applications. 3 lectures, 1 laboratory. Prerequisite: ME 329 and ME 405 or consent of instructor.

ME 410  Experimental Methods in Mechanical Design I (4)
Bonded resistance strain gages for static and dynamic measurements; rosettes, bridge circuits, lead wire effects, special gages. Photoelastic and moire fringe methods including birefringent coatings, shadow, and projection moire. Applications in mechanical design and metrology. 3 lectures, 1 laboratory. Prerequisite: ME 328.

ME 412  Composite Materials Analysis and Design (4)

ME 415  Energy Conversion (4)
Engineering aspects of energy sources, conversion and storage. Topics selected from fossil fuel systems, nuclear power, thermoelectric systems, thermionic converters, fuel cells, magnetohydrodynamic generators, and geothermal, tidal, wind and ocean temperature energy conversion systems. 4 lectures. Prerequisite: ME 302.

ME 416  Ground Vehicle Dynamics and Design (4)
Design of ground vehicles for directional stability and control. Tire mechanics and their effects on vehicle performance. Simulation of vehicle dynamics using digital computer. Synthesis of steering mechanism and suspension system. 2 lectures, 2 laboratories. Prerequisite: ME 318, ME 328.

ME 422  Mechanical Control Systems (4)
Modeling and control of physical systems. Design of mechanical, hydraulic and electrical systems using time response, frequency response,
ME 423 Robotics: Fundamentals and Applications (4)
Introduction to robots and their types. Homogeneous transformations. Kinematic equations and their solutions. Motion trajectories, statics, dynamics, and control of robots. Robot programming. Actuators, sensors and vision systems. 3 lectures, 1 laboratory. Prerequisite: ME 326, ME 422.

ME 424 Design of Piping Systems (4)
Pipe specifications and pertinent codes. Valves, fittings, pumps and compressors. The transportation function of piping as related to power plants, refineries, slurry systems, pumping systems and drainage. Philosophy of system design. 3 lectures, 1 laboratory. Prerequisite: ME 207, ME 347, CSC 231, MATE 210.

ME 428 Senior Design (3)
Component and system design from global integration point of view of various design parameters, using real life problems. Techniques of brainstorming, decision making, and feasibility studies. Industrial participation design program. 1 lecture, 2 laboratories. Prerequisite: ME 329, ME 343, ME 347, ENGL 149.

ME 431 Mechanical Design Techniques (4)
Comprehensive study of various design methods and techniques. Techniques used to explore various structural concepts such as prestressing, shaping, sizing, etc. Simulation of systems using digital computer. Design criteria identification of design parameters and constraints. 3 lectures, 1 laboratory. Prerequisite: ME 329.

ME 432 Petroleum Reservoir Engineering (4)
Types of reservoirs and reservoir rocks. Measurement and interpretation of physical properties of reservoir rocks and fluids: porosity, permeability, compressibility, electrical resistivity, fluid saturation, viscosity, solution gas and PVT properties of reservoir fluids. Introduction to flow in porous media, reserve calculations for different reservoirs and computer applications. 3 lectures, 1 laboratory. Prerequisite: ME 341.

ME 434 Enhanced Oil Recovery (4)
Primary, secondary, and tertiary (enhanced) oil recovery methods. Waterflooding, polymerflooding, gas injection, steam injection, in-situ combustion, chemical flooding, miscible flooding. Performance calculations and computer applications in EOR. 4 lectures. Prerequisite: ME 302, ME 347, ME 343.

ME 435 Drilling Engineering (4)
Theory and practice of oilwell planning, drilling, well logging, and completion applied to the development of new oil and gas production, from onshore and offshore fields. 4 lectures. Prerequisite: ME 329, ME 347.

ME 436 Petroleum Production Engineering (4)
Design and operation of surface and subsurface equipment required in oil production. Processes and systems involved are rod pumping, gas lifting, acidizing, hydraulic fracturing, fluid gathering and storage, separation of oil, gas, water and sediment from produced fluid. Includes equipment used in enhanced oil recovery processes. 4 lectures. Prerequisite: ME 329, ME 347.

ME 440 Thermal System Design (4)
Design and optimization of thermal systems. Engineering economics, thermal component sizing, steady-state simulation, and optimization techniques applied to the design and performance analysis of thermal systems. 3 lectures, 1 laboratory. Prerequisite: ME 303, ME 347, ME 343.

ME 441 Single Track Vehicle Design (4)
Handling qualities of two-wheeled vehicles, and the application to vehicle design. Modeling of single-track vehicles begins with the complete free body diagram of the steerable section and the dynamics of the vehicle. Laboratory demonstrations of geometry changes to the control spring and control authority. Determination of vehicle geometry values of cg position, longitudinal radius of gyration, headtube angle, etc. as their effect on handling qualities. 3 lectures, 1 laboratory. Prerequisite: ME 318, ME 326, ME 422 or consent of instructor.

ME 443 Turbomachinery (4)

ME 444 Combustion Engine Design (4)
Application of design parameters to the various engine cycles. Aspects of the combustion processes. Emission regulation effects on engine design. Static and dynamic loading. 3 lectures, 1 laboratory. Prerequisite: ME 303, ME 343.

ME 445 Convective Heat and Mass Transfer (4)
Forced convection in laminar and turbulent flow, free convection, diffusion, combined heat and mass transfer. 4 lectures. Prerequisite: ME 347, ME 343.

ME 446 Advanced and Hybrid Vehicle Design (4)
Systematic methodology to design and optimize hybrid powertrains. Exploration of conventional and hybrid powertrain subsystem models and application in a vehicle simulation, including internal combustion engines, electric motors and generators, transmissions, batteries, fuel cells, hydraulic reservoirs, ultracapacitors, flywheels, etc. Analytical modeling and optimization. 3 lectures, 1 laboratory. Prerequisite: ME 329 and ME 303.

ME 450 Solar Power Systems (4)
High and intermediate temperature systems for conversion of solar energy to mechanical power and heat. Thermal energy storage and total thermal energy system design. Recommended as a complement to ME 415. 3 lectures, 1 laboratory. Prerequisite: ME 343.

ME 456 HVAC Air and Water Distribution System Design (4)
Air and water distribution components and systems and the design of these systems with applications to the heating, ventilating and air-conditioning (HVAC) industry. 3 lectures, 1 laboratory. Prerequisite: ME 302, ME 347.

ME 457 Refrigeration Principles and Design (4)
Basic engineering principles of refrigeration processes including: vapor compression cycles, multipressure systems, absorption systems, steam jet cooling, air cycles, and low temperature refrigeration. 3 lectures, 1 laboratory. Prerequisite: ME 341, ME 343.

ME 458 Building Heating and Cooling Loads (4)
Building heating and cooling load calculations, estimating energy consumption and operating costs for heating, ventilating and air-conditioning system design and selection. 3 lectures, 1 laboratory. Prerequisite: ME 303, and ME 343.

ME 459 HVAC System Design (3)
Team project work in designing heating, ventilating and air-conditioning (HVAC) systems. Industry projects and collaborative work with other disciplines. 1 lecture, 2 laboratories. Prerequisite: ME 456, ME 458.

ME 461, 462 Senior Project I, II (2) (3)
Selection and completion of a project under faculty supervision. Projects typical of problems which graduates must solve in their fields of employment. Project results are presented in a formal report. Minimum 150 hours total time. Prerequisite: Senior standing, ME 303, ME 343 and ME 329 (or concurrent).

ME 463 Undergraduate Seminar (1)
New developments, policies, practices, and procedures discussed through seminar mode. Codes of ethics and case studies interpretations through panel discussions by students. 1 seminar. Prerequisite: Senior standing, ME 303, ME 343 and ME 329 (or concurrent).

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ME 470 Selected Advanced Topics (1–4)
Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 12 units. 1 to 4 lectures. Prerequisite: Consent of instructor.

ME 471 Selected Advanced Laboratory (1–4)
Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 8 units. 1 to 4 laboratories. Prerequisite: Consent of instructor.

ME 481, 482 Senior Project Laboratory I, II (2) (3)
Selection, development and completion of an accepted project done under faculty supervision. An enhanced opportunity to work on senior projects in teams. ME 481: an option to ME 461; 2 laboratories; prerequisite: senior standing, ME 303, ME 343, ME 329 (or concurrent). ME 482: an option to ME 462; 3 laboratories; prerequisite: ME 481 or equivalent.

ME 488 Wind Energy Engineering (4)
Engineering aspects of windpower systems including mechanical design, support structure design, aerodynamic analysis, wind field analysis, system concepts and analysis, and economics. 4 lectures. Prerequisite: ME 329, ME 342, ME 302.

ME 493 Cooperative Education Experience (2) (CR/NC)
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. Total credit limited to 6 units. Prerequisite: Sophomore standing and consent of instructor.

ME 494 Cooperative Education Experience (6) (CR/NC)
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. Total credit limited to 18 units. Prerequisite: Sophomore standing and consent of instructor.

ME 495 Cooperative Education Experience (12) (CR/NC)
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. A more fully developed formal report and evaluation by work supervisor required. Credit/No Credit grading only. Total credit limited to 24 units. Prerequisite: Sophomore standing and consent of instructor.

ME 500 Individual Study (1–3)
Advanced study planned and completed under the direction of a member of the department faculty. Open only to graduate students who have demonstrated ability to do independent work. Enrollment by petition. Prerequisite: Consent of department head, graduate advisor and supervising faculty member.

ME 501 Continuum Mechanics and Linear Elasticity (4)
Introduction to continuum mechanics. Kinematics, stress, and balance laws. Constitutive equations for isotropic and anisotropic solids and viscous fluids. Applications in mechanical engineering including design of beams and pressure vessels, stress concentrations, fiber-reinforced composites, and non-homogeneous biological materials. 4 lectures. Prerequisite: ME 401 or consent of instructor.

ME 502 Finite Element Analysis (4)
Approximate methods of stress analysis with emphasis on the theory of the Finite Element Method. Rayleigh-Ritz approximate energy minimizations and methods of weighted residuals applied to one- and two-dimensional stress fields. 3 lectures, 1 laboratory. Prerequisite: ME 501, or consent of instructor.

ME 503 Inelastic Stress Analysis (4)

ME 506 System Dynamics (4)
Unified approach for mathematical modeling and analysis of dynamic physical systems which may store energy in multiple energy domains. Emphasis on developing lumped-parameter linear system models from a set of primitive elements in a systematic manner. 4 lectures. Prerequisite: Graduate standing or consent of instructor.

ME 507 Mechanical Control System Design (4)
Application of principles of high-level design to mechanical control system implementation. Use of modified state transition logic in conjunction with object-oriented programming as design methodology. Real-time programming using above techniques for control of mechanical systems. 3 lectures, 1 laboratory. Prerequisite: Graduate standing or consent of instructor.

ME 517 Advanced Vibrations (4)
Vibration of complex engineering systems. Inertia and stiffness matrices. Natural frequencies and normal modes. Approximate solutions and computer techniques. Response to transient and periodic inputs. 3 lectures, 1 laboratory. Prerequisite: ME 318, graduate standing or consent of instructor.

ME 518 Machinery Vibration and Rotor Dynamics (4)
Vibrations relating to rotating machinery. Modeling of structural rotodynamic phenomena induced by shaft flexibility, bearings, and seals. Laboratory measurement of rotor system dynamic response and interpretation of machinery diagnostic information. Research project on a related topic. 3 lectures, 1 laboratory. Prerequisite: ME 318, graduate standing or consent of instructor.

ME 531 Acoustics and Noise Control (3)
Description of sound using normal modes and waves. Interaction between vibrating solids and sound fields. Sound absorption in enclosed spaces. Sound transmission through barriers. Applications in acoustic enclosures, room enclosures, room acoustics. Design of quiet machinery and transducers. 3 lectures. Prerequisite: ME 318, MATH 344.

ME 541 Advanced Thermodynamics (4)
Selected modern applications of thermodynamics which may include topics from: 1) equilibrium and kinetics as applied to combustion and air pollution, analysis and evaluation of techniques used to predict properties of gases and liquids, and 2) improvement of modern thermodynamic cycles by second law analysis. 4 lectures. Prerequisite: ME 303, ME 343, ME 347 and graduate standing or consent of instructor.

ME 542 Dynamics and Thermodynamics of Compressible Flow (4)
Control volume analysis of fluid-thermo equations for one-dimensional, compressible flow involving area change, normal shocks, friction, and heat transfer. Two-dimensional supersonic flow including linearization, method of characteristics, and oblique shocks. One-dimensional constant area, unsteady flow, 4 lectures. Prerequisite: ME 303, ME 343, ME 347, MATH 244, and graduate standing or consent of instructor.

ME 551 Mechanical Systems Analysis (4)
Various system modeling methods applied to mechanical systems. System stability studies and system optimization methods. 3 seminars, 1 laboratory. Prerequisite: Graduate standing or consent of instructor.

ME 552 Conductive Heat Transfer (3)
MSL 101 Foundations of Officership I (1)
Introduction to issues and competencies of the Army officer profession. Emphasis on stereotypes about the military, the role of the Army officer, customs and traditions within the military, and personal and physical development. Open to all freshmen and sophomores. 1 lecture.

MSL 102 Foundations of Officership II (1)
The role of leadership within a large organization. Emphasis on the definition of leadership, leadership framework, individual and organizational core values, and the moral responsibility of leadership. 1 lecture.

MSL 103 Basic Leadership (1)
The foundation of basic leadership fundamentals such as problem solving, communications, briefings and effective writing, techniques for improving listening and speaking skills, and an introduction to counseling. 1 lecture.

MSL 111 Orienteering (2)
Principles of orienteering, basic map reading and compass skills; course running techniques applied in field orienteering events. Open to all freshmen and sophomores. 1 lecture, 1 activity.

MSL 201 Individual Leadership Studies (2)
Identification of successful leadership traits through observation of others and self through experiential learning exercises. Recording of observed traits in a dimensional leadership journal, and discussion of observations in small groups. Open to all students. 2 lectures.

MSL 202 Leadership and Teamwork (2)
Application of leadership principles. Emphasis on understanding how to build teams, problem solving, building trust, and working with small groups. Identification of successful leadership traits through experiential learning exercises. Open to all students. 2 lectures.

MSL 203 Leadership Studies and Personal Development (2)
Focus on building character. Emphasis on personal development (reasoning and problem solving), making self-assessments, improving communication skills, improving physical well being, and diversity training (values and ethics). Open to all students. 2 lectures.

MSL 212 Leader's Training Course (1–7)
One to seven units of credit may be granted depending upon successful completion of training. Six weeks of training, Fort Knox, Kentucky. Travel pay and salary provided through the Military Science Department. No obligation. LTC graduates eligible to enroll in ROTC Advanced Program.

MSL 229 Ranger Challenge (2) (CR/NC)
Selection and preparation of the Ranger Challenge Team which will represent Cal Poly in military tactical skills competition. Includes rope bridging, orienteering, weapons knowledge, hand grenade accuracy, 10K road march with equipment, first aid, marksmanship, physical fitness and tactics. Credit/No Credit grading only. 2 activities.

MSL 301 Leadership and Problem Solving (3)
Introduction to principles of physical fitness and a healthy lifestyle fundamental to a military professional. Application of the Leadership Development Program, a formalized interactive process used to evaluate leadership performance and provide developmental counseling feedback in areas such as communication (verbal and nonverbal) and time management. Preparation, performance and evaluation of individual and small unit training. 3 lectures. Prerequisite: Completion of MSL 101, MSL 102, MSL 103, MSL 201, MSL 202, MSL 203, or completion of MSL 212, or consent of department head.

MSL 302 Leadership, Problem Solving, and Effective Communication (3)
Study of reasoning skills and communication skills. Emphasis on the use of these skills and their specific application in the form of the Army’s troop leading procedures. Detailed examination of officership and officereship case studies. 3 lectures. Prerequisite: MSL 301 and consent of instructor.

MSL 303 Leadership and Ethics (3)
Examination of the role communications, values, and ethics play in effective leadership. Topics include ethical decision-making, value of diversity, spirituality in the military, and examination of the Army leadership doctrine. Emphasis on improving oral and written communication. 3 lectures. Prerequisite: MSL 301, MSL 302, and consent of instructor.

MSL 314 Leadership Development and Assessment Course (6) (CR/NC)
Six week summer training program required to achieve an Army commission. Testing and training as functional Army officers and determination of potential for service. Travel pay, room and board, and salary are provided by the U.S. Army. Held at Fort Lewis, Washington. Credit/No Credit grading only. Prerequisite: MSC 311, MSC 312, MSC 313, and consent of instructor.

MSL 400 Special Problems for Advanced Undergraduates (1–2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of instructor.
MSL 401 Leadership and Management I (3)
Developing proficiency in planning and executing complex operations, functioning as a member of a staff, and mentoring subordinates. Emphasis on training management, methods of effective staff collaboration, and developmental counseling techniques. 3 lectures. Prerequisite: MSL 301, MSL 302, MSL 303 and consent of instructor.

MSL 402 Leadership and Management II (3)
Continuation of MSL 401 with a focus on communications and personal development. Study includes in-depth analysis of organizational culture and the dynamics of change, physical well-being, and practical exercises on establishing an ethical command climate. Series of leadership simulations. 3 lectures. Prerequisite: MSL 401 and consent of instructor.

MSL 403 Officership (3)
Case study analysis of military law, and practical exercises on establishing an ethical command climate. Completion of a quarter-long senior leadership project that requires planning, organizing, collaboration, analysis and demonstration of leadership skills. 3 lectures. Prerequisite: MSL 401 and consent of instructor.

MSL 470 Selected Advanced Topics (1–4)
Directed group study of selected topics for advanced students. Class Schedule will list topic selected. Total credit limited to 8 units. 1–4 lectures. Prerequisite: Consent of instructor.

MU—MUSIC

MU 100 Music Fundamentals (4)
Traditional music notation. Use of treble and bass staff for pitch and rhythm, harmonization using principal triads, major and minor, and common seventh chords. Performance of simple pieces individually and in groups using common classroom instruments. 3 lectures, 1 activity.

MU 101 Introduction to Music Theory (4)  GE C3
Introduction to the elements of music and their use by composers and performers. Notation of pitch and rhythm, scales, key signatures, intervals and chords. 3 lectures, 1 activity.

MU 103 Music Theory I: Diatomic Materials (4)
Structure of tonality, four-part writing of root position and inverted triads, cadences and melodic structure, harmonic progressions, harmonization of a melody and nonharmonic tones. Composition project. 4 lectures. Prerequisite: MU 101 or permission of instructor.

MU 104 Musicianship I (2)
Introductory sight-singing; rhythmic performance and dictation in simple and compound meters; identification and performance of melodic and harmonic intervals and triads; dictation of major diatonic melodies and basic chord progressions. 2 activities. Prerequisite: MU 101 or consent of instructor. (Music majors may be concurrently enrolled in MU 101 and MU 104.)

MU 106 Musicianship II (2)
Sight-singing in all forms of the minor mode; rhythmic performance and dictation in compound meters and syncopation; identification of triad inversions and cadence formulas; dictation of minor diatonic melodies and triadic chord progressions. 2 activities. Prerequisite: MU 104 or consent of instructor.

MU 114 Introduction to Composing (4)
Fundamental concepts in music composition. Creative projects. Compositional techniques, development, and structure. Analysis of examples from the literature. 3 lectures, 1 activity. Prerequisite: MU 101 or consent of instructor.

MU 120 Music Appreciation (4)  GE C3
Explores the world of music with emphasis on Western tradition. Language of music, the role of music in society. Historical context and major composers from the Middle Ages to the present. 3 lectures, 1 activity.

MU 121 Introduction to Non-Western Musics (4)
Survey of selected non-Western music cultures. Emphasis on listening and understanding the ensemble type, aesthetic principle, musical style, and performance practice of each. 3 lectures, 1 activity. Prerequisite: Music major, minor, or consent of instructor.

MU 149 Applied Study/Technique (1)
Individual instruction in performance with emphasis on the technical skills needed for the performance of repertoire. Total credit limited to 3 units. Specific areas of study are listed in the Class Schedule. Prerequisite: Consent of instructor.

MU 150 Applied Music (1)
Individual instruction in performance with emphasis on repertoire, technical skills, style, and interpretation. Total credit limited to 6 units. Specific areas of study are listed in the Class Schedule. Prerequisite: Consent of instructor.

MU 151 Beginning Piano (2)
Beginning piano for student with no background in keyboard instruments. Includes fundamentals of notation, keyboard techniques, tone production, sightreading and facility. 1 lecture, 1 activity.

MU 152 Elementary Class Piano (1)
Continuation of MU 151. Piano for students with the ability to play a simple Bach or Mozart Minuet. Total credit limited to 3 units. 1 activity. Prerequisite: MU 101 or MU 151 or equivalent. For non-music majors.

MU 153 Intermediate Class Piano (1)
Continuation of MU 152. Students are expected to play at the level of the easier Clementi Sonatinas. Total credit limited to 3 units. 1 activity. Prerequisite: MU 152 or one year of piano instruction. For non-music majors.

MU 154 Beginning Voice (2)
Beginning study of vocal and performance technique for the untrained singer. Includes the beginning study of the vocal mechanism and the fundamentals of notation. 1 lecture, 1 activity.

MU 155 Beginning Guitar (1)

MU 161 Piano Skills I (1)
Preparation for Piano Proficiency Examination. Study of piano repertoire, sightreading, transposition, harmonization or a melody, accompanying, improvisation of a melody. 1 activity. Prerequisite: Consent of instructor.

MU 162 Piano Skills II (1)
Continuation of MU 161. Preparation for Piano Proficiency Examination. Study of piano repertoire, sightreading, transposition, harmonization of a melody, accompanying, improvisation of a melody. 1 activity. Prerequisite: MU 161 or consent of instructor.

MU 163 Piano Skills III (1)
Continuation of MU 162. Preparation for Piano Proficiency Examination. Study of piano repertoire, sightreading, transposition, harmonization of a melody, accompanying, improvisation of a melody. 1 activity. Prerequisite: MU 162 or consent of instructor.

MU 170 University Jazz Band (1)
Study and public performance of music written for big band jazz. Limited to those who have had considerable experience playing musical instruments. The band performs concerts on campus and makes at least one tour annually. Total credit limited to 6 units. 1 laboratory. Prerequisite: Consent of instructor.

MU 171 Instrumental Ensembles (1)
Open to qualified musicians. Rehearsal and public performances in large and small ensembles. Total credit limited to 6 units. 1 activity. Prerequisite: Consent of instructor.
MU 172 Wind Orchestra (1)
Study and public performance of music written for large wind bands (woodwinds, brass, and percussion). Limited to those students who have had experience with wind and percussion instruments. The band performs concerts on campus and makes at least one tour annually. Total credit limited to 6 units. 1 laboratory. Prerequisite: Consent of instructor.

MU 173 Wind Ensemble (1)
Study and public performance of music written for wind ensembles (woodwinds, brass and percussion). Limited to those students who have had experience with wind and percussion instruments. Total credit limited to 6 units. 1 laboratory. Prerequisite: Consent of instructor.

MU 174 Symphony Orchestra (1)
Preparation and performance of orchestral music including both the standard repertoire and rarely performed works. Open to all students whose technique is adequate. Total credit limited to 6 units. 1 laboratory. Prerequisite: Consent of instructor.

MU 175 Contemporary Music Ensemble (1)
Open to all instrumentalists who are interested in performing recent classical literature. Limited to students who are proficient on their instrument. Total credit limited to 6 units. 1 laboratory. Prerequisite: By audition or consent of instructor.

MU 176 Mustang Band (1)
Public performance of music and specially-designed shows written for marching band (woodwinds, brass, percussion, and flag team auxiliary). Limited to those students who have had marching experience with wind and percussion instruments, or flag, rifle or dance lines. Total credit limited to 6 units. 1 laboratory. Prerequisite: Consent of instructor.

MU 181 PolyPhonics (1)
Study and public performance of music for mixed voices. Total credit limited to 6 units. 1 laboratory. Prerequisite: Consent of instructor.

MU 183 Vocal Ensemble (1)
Open to qualified singers. Rehearsal and performance of specialized vocal music. Total credit limited to 6 units. 1 activity. Prerequisite: Consent of instructor.

MU 184 Music Production Workshop (2)
Preparation of a musical theatre production for public presentation. Includes acting and stage management. Total credit limited to 6 units. 2 laboratories. Prerequisite: By audition or consent of instructor.

MU 185 University Singers (1)
Study and public performance of music for large mixed chorus. Total credit limited to 6 units. 1 laboratory. Prerequisite: Consent of instructor.

MU 187 Vocal Jazz Ensemble (1)
Study and performance of vocal jazz, including ensemble performance as well as solo performance and improvisation. Total credit limited to 6 units. 1 laboratory. Prerequisite: Consent of instructor.

MU 188 Vocal Practicum (1)
Study and implementation of performing techniques used by vocalists in a recital or concert setting. Total credit limited to 6 units. 1 activity. Prerequisite: MU 150, MU 250, MU 350 or MU 450, or consent of instructor.

MU 200 Special Problems for Undergraduates (4) (1-2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of instructor. Change effective Winter 2007.

MU 207 Music Theory II: Chromatic Materials (4)
Construction and resolution of diatonic and seventh chords, secondary dominants, basic modulation, change of mode. Augmented sixth and Neapolitan chords. Binary and ternary form. Composition project. 4 lectures. Prerequisite: MU 103.

MU 208 Musicianship III (2)
Sightsinging in all modes in two or more parts; rhythmic dictation in 2 parts; identification of triadic chord progressions and root position seventh chords; identification of phrase structure; dictation of two-part melodies in all modes. 2 activities. Prerequisite: MU 106 or consent of instructor.

MU 210 Musicianship IV (1)
Continuation of MU 208. Sightsinging with chromatic tones; rhythmic performance in changing meters; chord progressions with seventh chords and secondary dominants; seventh chord inversions; modulation to closely-related keys; identification of binary and ternary forms; and 2-part diatonic dictation. 1 activity. Prerequisite: MU 208 or consent of instructor.

MU 211 Musicianship V (1)
Continuation of MU 210. Sightsinging with non-diatonic tones; rhythmic performance and dictation in changing and irregular meters; chord progressions with Neapolitan and augmented sixth chords; modulatory progressions and dictations and identification of sonata, rondo, and variation forms. 1 activity. Prerequisite: MU 210 or consent of instructor.

MU 212 Musicianship VI (1)
Continuation of MU 211. Emphasis on previously acquired skills, plus performance and dictation of complex beat divisions; identification of contrapuntal genres; and modulatory dictation in 2 parts. 1 activity. Prerequisite: MU 211 or consent of instructor.

MU 221 Jazz Styles (4)  GE C3 USCP
Survey of Jazz as a significant American art form from 1900 to the present; its historical background and development in the United States; key elements, leading performers, and significant compositions in each style. Emphasis on listening skills. 3 lectures, 1 activity.

MU 229 Music of the 60s: War and Peace (4) GE C3 USCP
Explores wide spectrum of rock, folk and pop styles of the 60s. Relates music to social turmoil and historical trends, including Vietnam War, Civil Rights Movement, American Indian Movement, Chicano Movement, Free Speech Movement. 3 lectures, 1 activity.

MU 249 Applied Study/Technique (1)
Individual instruction in performance with emphasis on the technical skills needed for the performance of repertoire. Total credit limited to 3 units. Specific areas of study are listed in the Class Schedule. Prerequisite: Consent of instructor.

MU 250 Applied Music (1)
Individual instruction in performance with emphasis on repertoire, technical skills, style, and interpretation. Total credit limited to 6 units. Specific areas of study are listed in the Class Schedule. Prerequisite: 3 units of MU 150 and consent of instructor.

MU 251 Diction for Singers (1)
The study of diction as it applies to singing in English, French, German, Italian and Spanish. Class Schedule will list topic elected. Total credit limited to 3 units. 1 activity. Prerequisite: Consent of instructor.

MU 252 Intermediate Voice (1)
Vocal and performance technique for experienced singers. Total credit limited to 3 units. 1 activity. Prerequisite: Consent of instructor.

MU 253 Advanced Class Piano (1)
Advanced level piano techniques with emphasis on style, interpretation, sightreading, basic performance practices and the solution to general musical problems. Total credit limited to 3 units. 1 activity. Prerequisite: MU 153 or consent of instructor. For non-music majors.

MU 259 Beginning Jazz Improvisation (2)
Development of fundamentals of jazz improvisation including scales, arpeggios, patterns, swing feel, expressiveness, and motifs through in-class performance of written materials and improvisations with play-along recordings. Total credit limited to 6 units. 2 activities. Prerequisite: Facility on a musical instrument or singing ability; MU 101 or consent of instructor.
MU 200 Intermediate Jazz Improvisation (2)
Further development of fundamentals of jazz improvisation including alternate scales, arpeggios, embellishments, expressiveness, and motifs through in-class performance of written materials and improvisations with play-along recordings. Total credit limited to 6 units. 2 activities. Prerequisite: Successful completion of MU 259 or consent of instructor.

MU 261 Piano Skills IV (1)
Continuation of MU 163. Preparation for Piano Proficiency Examination. Study of piano repertoire, sightreading, transposition, harmonization of a melody, accompanying, and improvisation of a melody. 1 activity. Prerequisite: MU 163 or consent of instructor.

MU 262 Piano Skills V (1)
Continuation of MU 261. Preparation for Piano Proficiency Examination. Study of piano repertoire, sightreading, transposition, harmonization of a melody, accompanying, and improvisation of a melody. 1 activity. Prerequisite: MU 261 or consent of instructor.

MU 263 Piano Skills VI (1)
Continuation of MU 262. Successful completion of this course represents fulfillment of the Piano Proficiency Examination. Study of piano repertoire, sightreading, transposition, harmonization of a melody, accompanying, and improvisation of a melody. 1 activity. Prerequisite: MU 262 or consent of instructor.

MU 301 Counterpoint (4)
Counterpoint as a compositional technique. Modal, tonal, and post-tonal practices. Creative project. 4 lectures. Prerequisite: MU 207.

MU 308 Sound Design: Technologies (4)
Fundamental tools of electroacoustic sound design. Concepts and application of music studio procedure, recording, synthesis, and MIDI. Studio projects. 3 lectures, 1 activity. Prerequisite: MU 101, MU 120 or consent of instructor.

MU 309 Music Theory III: Advanced Chromaticism (4)
Compositional procedures employed by composers of the Classical and Romantic periods. Chromatic third-related harmony, ninth, eleventh and thirteenth chords. Chromatic and enharmonic modulation. Sonata and rondo form. Composition project. 4 lectures. Prerequisite: MU 207.

MU 310 Sound Design: Recording (4)
Exploring creative use of recording technology. Analog and digital equipment for recording music. Analysis and creative projects. 3 lectures, 1 activity. Prerequisite: MU 308 or permission of instructor.

MU 315 Music Fundamentals in the Classroom (4)
Music skills and concepts for non-musicians developed through "learn-by-doing" music education pedagogies. Methodologies and state standards for teaching classroom music, performance skills (singing, recorder, accompanying instruments, body percussion). 3 lectures, 1 activity. Prerequisite: Completion of GE Area A and consent of instructor.

MU 320 Music Research and Writing (4)
Methodology for researching, analyzing, and writing about music. Exploration of investigative tools including library resources, periodicals, bibliographic tools, computerized search methods. Computerized software for text and music notation. Formatting music for publication. Performance practice. 4 lectures. Prerequisite: MU 207 and ENGL 134. Recommended: MU 120; or permission of instructor.

MU 324 Music and Society (4)
Exploration into the role of music historically and culturally. Emphasis on deeper understanding and appreciation of the context of music through topics of special interest. Class Schedule will list topics selected. Total credit limited to 12 units. 3 lectures, 1 activity. Prerequisite: Completion of GE Area A and a foundation course in Area C. Music majors will not receive GE C4 credit.

MU 325 America's Music (4)
Explorations of the many styles of America's music through lectures, readings, sound recordings, musical scores, and performance. Includes "Native American," "folk," "popular," and "fine art" traditions. How American music reflects the different cultural heritages, social contexts, and philosophies of its creators. 4 lectures. Prerequisite: MU 207. Recommended: MU 120.

MU 326 Cultural Concepts and Structures in Music (4)
Exploring the definition, concepts, and structures of music in terms of theory, performance practice, and compositional procedures of selected non-Western cultures. 3 lectures, 1 activity. Prerequisite: Junior standing or consent of instructor.

MU 328 Women in Music (4)
Survey of women's contributions as composers and performers of western art and popular music; historical overview of the experiences and perception of women as musicians. 3 lectures, 1 activity. Prerequisite: Completion of GE Area A and a foundation course in Area C. Music majors will not receive GE C4 credit.

MU 331 Music of the Middle Ages and Renaissance (4)
Musical literature, styles, composers, theory, genres and notation of the Middle Ages and Renaissance. Relationship to historical trends. 4 lectures. Prerequisite: MU 320; Recommended: MU 120; or permission of instructor.

MU 332 Music of the Baroque and Early Classic Eras (4)
Survey of the history of western art music from 1600 to 1780. 4 lectures. Prerequisite: MU 320; Recommended: MU 120; or permission of instructor.

MU 333 Music of the Classic and Romantic Eras (4)
Survey of the history of western art music from 1780 to 1900. 4 lectures. Prerequisite: MU 320; Recommended: MU 120; or permission of instructor.

MU 334 Music of the Modern Era (4)
Composers, important works, and significant trends in the Western European and American classical tradition during the 20th and 21st Centuries. 4 lectures. Prerequisite: MU 320; Recommended: MU 120; or permission of instructor.

MU 335 Survey of Keyboard Literature (4)
Intensive survey of solo piano literature from early keyboard music through contemporary composers; emphasis upon composers' influences, stylistic characteristics, performance practices, and the development of the pianoforte. 4 lectures. Prerequisite: MU 207 or consent of instructor.

MU 336 Jazz History and Theory (4)
Survey of Jazz theoretical techniques. Emphasis upon historical context and development of Jazz through study and analysis of scores and historical performances. 4 lectures. Prerequisite: MU 207.

MU 340 Conducting: Fundamentals (2)
Principles and techniques of conducting with experience in score reading. 2 activities. Prerequisite: MU 207 or consent of instructor.

MU 341 Conducting: Choral (2)
Continuation of MU 340. Emphasis on choral literature. Score reading, rehearsal techniques, and musical details associated with vocal music. 2 activities. Prerequisite: MU 340.

MU 342 Conducting: Instrumental (2)
Continuation of MU 340. Emphasis on band and orchestra literature. Score reading, rehearsal techniques, and musical details associated with instrumental music. 2 activities. Prerequisite: MU 340 and MU 341.

MU 349 Applied Study/Technique (1)
Individual instruction in performance with emphasis on the technical skills needed for the performance of repertoire. Total credit limited to 3 units. Specific areas of study are listed in the Class Schedule. Prerequisite: Consent of instructor.
MU 350  Applied Music (1)
Individual instruction in performance and composition. Total credit limited to 6 units. Specific areas of study are listed in the Class Schedule. Prerequisite: Consent of instructor.

MU 351  Jazz and Popular Music Arranging (2)
Arranging for small and large jazz ensembles. Score and part preparation. 2 activities. Prerequisite: MU 207.

MU 352  Orchestration (4)
Ranges, transposition, technical capabilities, and scoring of vocal ensembles, band, and orchestra instruments. Creative project. 3 lectures, 1 activity. Prerequisite: MU 207.

MU 360  Music for Classroom Teachers (4)
Development of skills for fostering creative music experiences in the classroom. Exploration of various approaches to motivating children musically. Study of folk songs for singing, playing instruments, and learning about music as well as for their ethnic and cultural significance. 3 lectures, 1 activity. Prerequisite: MU 100 or MU 101.

MU 361  Instruments (1)
Fundamentals of playing and teaching woodwind, brass, string, and percussion instruments. Separate sections in specific areas of study are arranged with instructor. Total credit limited to 6 units. 1 activity. Prerequisite: Junior standing and consent of instructor.

MU 365  Music in the Elementary School (4)
Study and application of Orff, Dalcroze, Kodaly, Manhattanville, and Suzuki. Philosophy, objectives and methodologies for implementing an effective school music program. Includes fieldwork. 3 lectures, 1 activity. Prerequisite: MU 207; junior standing.

MU 366  Piano Pedagogy (2)
Survey of elementary, intermediate and advanced teaching methods and literature; private and group instruction; studio policies. 2 activities. Prerequisite: MU 207 or consent of instructor.

MU 370  University Jazz Band (1)
Study and public performance of music written for big band jazz. Limited to those who have had considerable experience playing musical instruments. The band performs concerts on campus and makes at least one tour annually. Total credit limited to 6 units. 1 laboratory. Prerequisite: Junior standing and consent of instructor.

MU 371  Instrumental Ensemble (1)
Open to qualified musicians. Rehearsal and public performance in large and small ensembles. Total credit limited to 6 units. 1 activity. Prerequisite: Junior standing and consent of instructor.

MU 372  Wind Orchestra (1)
Study and public performance of music written for large wind band (woodwinds, brass and percussion). Limited to those students who have had experience with wind and percussion instruments. The band performs concerts on campus and makes at least one tour annually. Total credit limited to 6 units. 1 laboratory. Prerequisite: Junior standing and consent of instructor.

MU 373  Wind Ensemble (1)
Study and public performance of music written for wind ensemble (woodwinds, brass and percussion). Limited to those students who have had experience with wind and percussion instruments. Total credit limited to 6 units. 1 laboratory. Prerequisite: Junior standing and consent of instructor.

MU 374  Symphony Orchestra (1)
Preparation and performance of orchestral music including both the standard repertoire and rarely performed works. Open to all students whose technique is adequate. Total credit limited to 6 units. 1 laboratory. Prerequisite: Junior standing and consent of instructor.

MU 375  Contemporary Music Ensemble (1)
Open to all instrumentalists who are interested in performing recent classical literature. Total credit limited to 6 units. 1 activity. Prerequisite: Junior standing; by audition or consent of instructor.

MU 376  Mustang Band (1)
Public performance of music and specially-designed shows written for marching band (woodwinds, brass, percussion, and flag team auxiliary). Limited to those students who have had marching experience with wind and percussion instruments, or flag, rifle or dance lines. Total credit limited to 6 units. 1 laboratory. Prerequisite: Junior standing and consent of instructor.

MU 381  PolyPhonics (1)
Study and public performance of music for mixed voices. Total credit limited to 6 units. 1 laboratory. Prerequisite: Junior standing and consent of instructor.

MU 383  Vocal Ensemble (1)
Open to qualified singers. Rehearsal and performance of specialized vocal music. Total credit limited to 6 units. 1 activity. Prerequisite: Junior standing and consent of instructor.

MU 384  Music Production Workshop (2)
Preparation of a musical theatre production for public presentation, including acting and stage management. Total credit limited to 6 units. 2 laboratories. Prerequisite: Junior standing and by audition, or consent of instructor.

MU 385  University Singers (1)
Study and public performance of music for large mixed chorus. Total credit limited to 6 units. 1 laboratory. Prerequisite: Junior standing and consent of instructor.

MU 387  Vocal Jazz Ensemble (1)
Study and performance of vocal jazz, including ensemble performance as well as solo performance and improvisation. Total credit limited to 6 units. 1 laboratory. Prerequisite: Junior standing and consent of instructor.

MU 389  Vocal Practicum (1)
Study and implementation of performing techniques used by vocalists in a recital or concert setting. Total credit limited to 6 units. 1 activity. Prerequisite: MU 150, MU 250, MU 350 or MU 450, or consent of instructor.

MU 400  Special Problems for Advanced Undergraduates (1–2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Junior standing and consent of department head.

MU 401  Music Theory IV: Contemporary Practices (4)
Examination of modern compositional practices including impressionism, polytonality, serialism, timbre and form, minimalism, and the new eclecticism. Analysis and creative projects. 4 lectures. Prerequisite: MU 309 or permission of instructor.

MU 411  Sound Design: Synthesis (4)
Compositional application of sound synthesis techniques. Realization of computer music. Creative projects. 3 lectures, 1 activity. Prerequisite: MU 310.

MU 412  Sound Design: Composition and Production (4)
Production of electroacoustic music in media. Program analysis, technical planning, composition, and product development. 3 lectures, 1 activity. Prerequisite: MU 310.

MU 420  Music History: Selected Topics (4)
Intensive study of selected topics in music history through the use of readings, recordings, scores, and class presentations. Class Schedule will list topics selected. Total credit limited to 8 units. 3 lectures, 1 activity. Prerequisite: MU 331, MU 332, MU 333, MU 334, or consent of instructor.
MU 449 Applied Study/Technique (1)
Individual instruction in performance with emphasis on the technical skills needed for the performance of repertoire. Total credit limited to 3 units. Specific areas of study are listed in the Class Schedule. Prerequisite: Consent of instructor.

MU 450 Applied Music (1)
Individual instruction in performance and composition. Total credit limited to 6 units. Specific areas of study are listed in the Class Schedule. Prerequisite: Consent of instructor.

MU 461 Senior Project (3)
Selection and completion of a project under faculty supervision. Minimum of 90 hours total time. Results presented in a recital, creative work, formal report, or a combination of all three. Prerequisite: Senior standing and consent of department head.

MU 465 Choral Literature and Rehearsal Techniques (4)
Survey of choral literature especially suited for secondary schools. Philosophy and strategy for developing a school program. Musical as well as non-musical techniques for effective rehearsal. 3 lectures, 1 activity. Prerequisite: MU 341, or consent of instructor.

MU 466 Instrumental Literature and Rehearsal Techniques (4)
Survey of instrumental literature especially suited for secondary schools. Philosophy and strategy for developing a school program. Musical as well as non-musical techniques for effective rehearsal. 3 lectures, 1 activity. Prerequisite: MU 342, or consent of instructor.

PE–PHYSICAL EDUCATION

(See also KINE–Kinesiology)

BASIC INSTRUCTIONAL PROGRAM
Enrollment is open to all students except for designated intramural courses. Courses carry 1 unit of credit, meet 2 hours per week, and are designed to develop skill, knowledge of rules, background and analysis of techniques, and desirable attitudes toward physical fitness and participation in physical activities.

The beginning course or its equivalent is prerequisite to the intermediate, and the intermediate to the advanced. Prerequisite may be waived by consent of the instructor.

No more than two different activity courses nor more than one section of an individual activity course may be taken for credit in any one quarter. A student may not enroll simultaneously in the same quarter for a beginning, intermediate and/or advanced activity course. Any level of an activity course can be repeated only once for credit.

Students not majoring in kinesiology may apply a maximum of 12 units of credit earned in general and intramural activity courses toward the bachelor’s degree.

All basic instructional courses (PE 100–176) are evaluated on a Credit/No Credit basis. A miscellaneous course fee may be required—see Class Schedule.

Coed
PE 100 Adaptive Activity
PE 101 Gymnastics
PE 102 Tumbling and Vaulting
PE 103 Archery
PE 104 Badminton, Beg.
PE 105 Badminton, Int.–Adv.
PE 107 Billiards
PE 108 Basketball
PE 109 Bowling
PE 110 Cycling
PE 111 Fencing
PE 112 Bowling, Int.
PE 113 Intermediate Billiards
PE 116 Aerobic Exercise
PE 121 Golf, Beg.
PE 122 Golf, Int.–Adv.
PE 125 Jogging
PE 126 Judo
PE 129 Stretch, Flex and Relax
PE 131 Physical Conditioning
PE 132 Racquetball, Beg.
PE 133 Racquetball, Int.–Adv.
PE 135 Skin Diving
PE 136 Scuba Diving
PE 137 Self-Defense
PE 138 Karate
PE 139 Soccer
PE 140 Ultimate Disc
PE 142 Softball
PE 143 Swimming for Non-Swimmers
PE 144 Swimming, Advanced Beginner
PE 145 Swimming, Int.
PE 146 Swimming, Adv.
PE 147 Swim Conditioning
PE 148 Tennis, Beg.
PE 149 Tennis, Int.–Adv.
PE 151 Volleyball, Beg.
PE 152 Volleyball, Int.–Adv.
PE 154 Weight Training
PE 156 Aqua-Aerobics
PE 159 Wrestling
PE 174 Intramurals
PE 176 Fitness Walking

COMPETITIVE ATHLETICS
Enrollment limited to those academically qualified to compete in intercollegiate athletic programs. Consent of coach required. Total credit limited to 8 units. Courses are each 2 units and meet for a minimum of 10 hours per week. All competitive athletics courses are evaluated on a Credit/No Credit basis.

Men
PEM 182 Baseball
PEM 183 Basketball
PEM 184 Cross Country
PEM 185 Football
PEM 189 Soccer
PEM 191 Swimming
PEM 192 Tennis
PEM 193 Track and Field
PEM 196 Wrestling

Women
PEW 183 Basketball
PEW 184 Cross Country
PEW 189 Soccer
PEW 190 Softball
PEW 191 Swimming
PEW 192 Tennis
PEW 193 Track and Field
PEW 194 Volleyball

PROFESSIONAL ACTIVITIES – See KINE–Kinesiology

ACADEMIC COURSES – See KINE–Kinesiology

PHIL–PHILOSOPHY

PHIL 126 Logic and Argumentative Writing (4) GE A3
Principles of argument analysis, evaluation and construction. Deductive and inductive reasoning, including analogical arguments, universal and statistical generalizations, and causal inferences. Principles of organizing and writing argumentative essays. Moral dimensions of rational discourse. 4 lectures. Prerequisite: Completion of GE Areas A1 and A2.
PHIL 225 Symbolic Logic (4)  
The nature of deductive logical systems. Methods of notation, translation and proof in the sentential, predicate and relational calculi including indirect and conditional methods of proof. 4 lectures. Prerequisite: Completion of GE Area A3.

PHIL 230 Philosophical Classics: Metaphysics and Epistemology (4) (Also listed as HNRS 230)  GE C2
Study of several classic works from the history of philosophy on issues in metaphysics and epistemology. At least one will be from the Ancient period, and at least one from the Modern era. No more than one from the twentieth century. 4 lectures. Prerequisite: Completion of GE Area A.

PHIL 231 Philosophical Classics: Social and Political Philosophy (4) (Also listed as HNRS 231)  GE C2
Readings from primary philosophical texts, from the ancient and modern periods, with focus on the identification and evaluation of the central ethical and political themes and arguments presented in them. 4 lectures. Prerequisite: Completion of GE Area A.

PHIL 311 Greek Philosophy (4)  GE C4
Beginnings of Western philosophy and science. The Presocratics, Socrates, Plato, and Aristotle. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 312 Medieval Philosophy (4)  GE C4
Development of Western philosophy from Augustine to Ockham, including Anselm, Abelard, Roger Bacon, Bonaventure, Aquinas, and Duns Scotus. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 313 Continental Philosophy: Descartes to Leibniz (4)  GE C4
Development of Western philosophy from the late Renaissance through Leibniz, with special emphasis upon the epistemology and metaphysics of the Continental Rationalists. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 314 British Philosophy: Bacon to Mill (4)  GE C4
Development of Western philosophy from the Renaissance through Mill, with special emphasis on British Empiricism. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 315 German Philosophy: Kant to Nietzsche (4)  GE C4
Primary issues and concepts found in German philosophy from 1780 to 1900, with emphasis on Kant, Hegel, and Nietzsche. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 316 Contemporary European Philosophy (4)  GE C4
Recent movements within the Continental tradition, including French and German existentialism, phenomenology, and post-metaphysical philosophy. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 317 Contemporary British and American Philosophy (4)  GE C4
Major developments within 20th century British and American philosophy, with focus chiefly around Analytic philosophy. Other schools, such as Pragmatism, may be included, as may some philosophers outside of Britain and America whose work was influential in those countries. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 320 Asian Philosophy (4)  GE C4
Philosophies developed in India, South Asia, China and Japan, including the logical and epistemological presuppositions of the Six Schools of Hindu metaphysics, Buddhist philosophy, Confucian moral philosophy, Taoist metaphysics and social ecology. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 321 Philosophy of Science (4)  GE C4
The rational foundations of inquiry and explanation in the physical, biological and social sciences. Justification of scientific claims, the difference between science and pseudoscience, the relationship between science and other fields of investigation. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 322 History of Ethics (4)  GE C4
The history of moral thought from Homer and the Pre-Socratics to the 20th century, and focus on theories of moral goodness and rightness of action. Related issues and areas of thought, e.g. metaphysics, theology, science, politics, psychology freedom/determinism to be considered, where they shed light on moral thought. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 331 Ethical Theory and Social Justice (4)  GE C4
Examination of contemporary moral problems, solutions to these problems, and the arguments for these solutions, with emphasis on two or more of the following sample problem areas: abortion, suicide and euthanasia, capital punishment, family ethics, race relations, social justice, war, women’s issues. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 332 History of Ethics (4)  GE C4
Critical examination of the relations between gender, ethnicity and norms of the proper function of the state, and the relation of these theories to issues in metaphysics, theory of knowledge, and ethics. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 333 Political Philosophy (4)  GE C4

PHIL 334 Business Ethics (4)  GE C4
Ethical issues in contemporary applied ethics. Joint focus on theory and application. 4 lectures. Prerequisite: Completion of GE Area A and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 335 Social Ethics (4)  GE C4 USCP
Examination of contemporary moral problems, solutions to these problems, and the arguments for these solutions, with emphasis on two or more of the following sample problem areas: abortion, suicide and euthanasia, capital punishment, family ethics, race relations, social justice, war, women’s issues. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 336 Ethics, Gender and Society (4)  GE C4 USCP
Critical examination of the relations between gender, ethnicity and norms of the proper function of the state, and the relation of these theories to issues in metaphysics, theory of knowledge, and ethics. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 337 Business Ethics (4)  GE C4
Critical examination of ethical problems that arise in business. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 338 Ethics and Education (4)  GE C4
Critical discussion of moral issues as a means to the educational goals of autonomy and freedom. Critical examination of major ethical theories. Examination of classroom approaches to discussions of ethical values and moral controversy in education. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 339 Biomedical Ethics (4)  GE C4
Critical examination of problems in biomedical ethics, proposed solutions to these problems, and the arguments for such solutions. Emphasis on two or more of the following sample problem areas: concepts of health and
disease, human experimentation, informed consent, behavior control, genetic intervention, new birth technologies, euthanasia and physician-assisted dying. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 340 Environmental Ethics (4) GE C4
Analyses of various positions on the moral status of nonhuman entities and problems such as the treatment of animals, wilderness preservation, population, pollution and global warming. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 342 Philosophy of Religion (4) GE C4
Inquiry into the rational and nonrational bases of religious claims. Arguments for and against the existence of God. Discussion of miracles, revelation, the definition of God, the problem of evil, the relation of faith and reason, the nature of religious experience, the verification of religious claims. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 350 Aesthetics (4) GE C4
Critical examination of philosophical views of art from both a historical and contemporary perspective. Treatment of theories from Plato and Aristotle through those of the twentieth century. Discussion of the problems raised by modern art. The relation between aesthetic values and metaphysics, epistemology, ethics and politics. 4 lectures. Prerequisite: Completion of GE Area A, and PHIL 230 or PHIL 231. Philosophy majors will not receive GE C4 credit.

PHIL 400 Special Problems for Advanced Undergraduates (1–2)
Individual investigation, research, studies or surveys of selected problems. Prerequisite: Consent of department chair.

PHIL 411 Metaphysics (4)
Traditional and current ideas and arguments about substance, the relation of universals to particulars, space and time, events, causation and necessity, the self and free will. 3 lectures, research paper. Prerequisite: PHIL 230.

PHIL 412 Epistemology (4)
Analysis of the concept of knowledge. Development of competing theories of epistemic justification and truth. Inquiry into relationship between knowledge, belief, justification and truth. Examination of skepticism. 3 lectures, research paper. Prerequisite: PHIL 230.

PHIL 421 Philosophy of Space, Time and Matter (4)
Investigation of the philosophical foundations and interpretation of relativity theory and elementary quantum mechanics. Emphasis on philosophical issues relevant to contemporary philosophy of science such as scientific realism. Some discussion of very recent theories of space, time, and matter. 3 lectures, research paper. Prerequisite: Completion of Area A and PHIL 230 or PHIL 321.

PHIL 422 Philosophy of Mind (4)
Classic and current work in the problems and issues of the nature and unity of the self, consciousness, mental representations, and action, and of the relation of philosophy of mind to psychology, linguistics and computer science. 3 lectures, research paper. Prerequisite: PHIL 230 or PHIL 231.

PHIL 429 Special Topics in the History of Philosophy (4)
Advanced discussion of selected topics in the history of philosophy. Examination and analysis of important philosophical movements (e.g., positivism, postmodernism) or alternatively, of particular philosophers or philosophical works of exceptional importance (e.g., David Hume; Kant’s Critique of Pure Reason). Class Schedule will list topic selected. Total credit limited to 12 units. 3 lectures, research paper. Prerequisite: PHIL 230.

PHIL 439 Selected Problems in Ethics and Political Philosophy (4)
Advanced discussion of selected topics in ethics and political philosophy. Examination and analysis of significant ethical or political theories (e.g., utilitarianism, contractarianism) or alternatively, of particular philosophers or philosophical works of exceptional importance (e.g., John Stuart Mill; John Rawls’ A Theory of Justice). Class Schedule will list topic selected. Total credit limited to 8 units. 3 lectures, research paper. Prerequisite: PHIL 231 and PHIL 331 or PHIL 333.

PHIL 449 Selected Topics in Recent Philosophy (4)
Advanced discussion of selected topics in recent philosophy. Examination and analysis of important recent movements in central philosophical areas (e.g., metaphysics, epistemology, philosophy of science, philosophy of language, philosophy of mind) or, alternatively, of particular philosophers or philosophical works of exceptional recent importance. 3 lectures, research paper. Prerequisite: Completion of GE Area A and PHIL 230.

PHIL 460, 461 Senior Project I, II (2) (2)
Selection, development and completion of a project under faculty supervision. Results presented in a formal thesis. Minimum of 60 hours per quarter. Requirements for PHIL 460 must be completed before student can enroll in PHIL 461. Prerequisite: Senior standing, consent of instructor.

PHIL 470 Selected Advanced Topics (1–4)
Directed group study of selected topics for advanced students. Class Schedule will list topics selected. Total credit limited to 8 units. 1–4 lectures. Prerequisite: Consent of instructor.

PHYS–PHYSICS

PHYS 104 Introductory Physics (4) GE B3
Elementary introduction to mechanics, gases, liquids and solids, heat, vibrations and waves, light, electricity and magnetism. Intended to provide non-science students with an understanding of basic physical concepts. Not open to students who have credit in a college physics course. 4 lectures. Prerequisite: Passing score on the ELM examination, or an ELM exemption.

PHYS 107 Introduction to Meteorology (4) GE B3
Physics of Earth’s atmosphere. Topics include the physical basis for temperature, wind generation, atmospheric circulation, humidity, adiabatic processes, cloud formation, cyclone development, precipitation, and storm growth. Other topics include the variety of storms and their effects, satellite imaging, and air pollution and its possible effect on global temperature change. 4 lectures. Prerequisite: Passing score on the ELM examination for MATH 116 eligibility, or an ELM exemption, or MATH 104.

PHYS 111 Modern Physics for Poets (4) GE B3
Non-mathematical exploration of the key concepts of quantum mechanics and Einstein’s special and general theories of relativity. Particle-wave duality, Heisenberg’s uncertainty principle, Schrodinger’s cat, warped spacetime, black holes. 4 lectures.

PHYS 121 College Physics I (4) GE B3 & B4
Introductory course in mechanics emphasizing motion, force, and energy. Not open to students having a grade of C- or better in PHYS 131. 3 lectures, 1 laboratory. Prerequisite: MATH 118 and high school trigonometry, or MATH 119 or MATH 120.

PHYS 122 College Physics II (4)
Continuation of PHYS 121. Topics include properties of materials, fluids, waves and vibrations, sound, heat, light and optics. Not open for credit to students having a grade of C- or better in PHYS 132. 3 lectures, 1 laboratory. Prerequisite: PHYS 121.

PHYS 123 College Physics III (4)
Continuation of PHYS 121 and 122. Electrostatics, electric current, magnetic fields and induction. Elements of modern physics. Not open for credit to students having a grade of C- or better in PHYS 133. 3 lectures, 1 laboratory. Prerequisite: PHYS 121. Recommended: PHYS 122.