CHINESE

See Linguistics and Oriental and African Languages

CIVIL AND SANITARY ENGINEERING

College of Engineering

Civil Engineering C E

251. *Elementary Surveying*
Fall, Spring. 4(3-3) Trigonometry, EGR 160 or 267. Not open to majors.
Use of the tape, compass, level, and transit with simple maps; traverse closure and area computations. Profile, cross section and stadia surveys, U. S. land system.

252. *Surveying I*
Fall, Spring. 5(4-3) Trigonometry.
Instruments, theory of measurements, error analysis, stadia, horizontal and vertical curves, U.S. Public Land System, observation for meridian.

280. *Introduction to Environmental Engineering*
(382.) Fall, Winter, Spring. 4(4-0) CEM 141 or 131, MTH 112, CPS 120.
Hydrology; ground water and surface water supply systems; wastewater treatment, methods of pollution control for solid waste, air, and noise.

305. *Structural Mechanics I*
Winter, Spring. 4(4-0) MMM 211.
Stability and determinacy of structures. Two and three dimensional determinate structures. Indeterminate structural analysis by displacement and force methods based upon equilibrium, compatibility and load-deformation relations.

308. *Engineering Materials I*
Winter, Spring. 4(3-3) MMM 211 or concurrently.
Structure; composition; physical, mechanical and rheological properties of non-metallic construction materials. Emphasis on aggregates, asphalt, inorganic cements, concrete, and wood.

311. *Urban Utilities*
Winter. 3(3-0)
Capacities, limitations and cost of public and semi-public utilities as they relate to the planning and design of the urban environment. Topics include transportation, water supply, storm drainage, sewage collection and treatment, solid waste and municipal finance.

312. *Soil Mechanics I*
Spring, Summer. 4(3-3) MMM 211.
Engineering properties of soils and their measurement. Effective stress concept; permeability; fluid flow in soils; stress-strain behavior; soil strength; compaction and consolidation of soils; field exploration and design problems.

321. *Introductory Fluid Mechanics*
Fall, Winter, Spring. 5(4-2) MMM 306
Fluid properties; hydrostatics; control volume approach to conservation of mass, momentum and energy; dimensional analysis and dynamic similitude; fluid resistance; pipe and open channel flows; boundary layer concepts.

342. *Survey of Transportation Systems*
Fall. 4(4-0) Juniors; not open to majors.
Survey of engineering aspects of all forms of transportation with emphasis on highway transportation including highway systems, planning, economic and financial aspects, geometrics and traffic studies.

346. *Transportation*
(446.) Fall, Winter, Summer. 3(3-0) MTH 214.
Planning, design and evaluation of transportation systems. Operational characteristics of transportation modes, traffic flow and techniques for system selection.

347. *Transportation Facilities*
(447.) Winter. 4(3-3) 251 or 252.
Geometric design of highway and airport facilities as these considerations affect capacity, traffic control and economics of transport systems. Financing and administration of transport systems.

353. *Surveying II*
Spring. 4(3-3) 251 or 252.
Continuation of 252 including photogrammetric methods, astronomical observations for latitude, longitude and meridian. Introduction to geodetic methods.

370. *Cost and Optimization Engineering*
Fall, Winter. 3(3-0) MTH 113.
Formulation of engineering decisions governed by current and future costs and returns. Comparison and optimization of alternative engineering projects, products and processes.

372. *Construction Estimating*
Fall, Spring. 3(3-0) Juniors.
Cost studies of construction activities with emphasis on labor productivity and operating characteristics of equipment under various site conditions. Interpretation of drawings and specifications.

374. *Legal Aspects of Engineering*
Spring. 3(3-0) Juniors.
The professional engineer's relationship with the legal aspects of engineering. Special emphasis on contract documents.

390. *Civil Engineering Analysis*
Fall, Spring. 4(4-0) MTH 215 and CPS 120.
Analysis of civil engineering problems by numerical and statistical methods. Approximate methods and error analysis. Application to computer use.

400. *Structural Mechanics II*
Spring, Summer. 4(4-0) 305.
Energy methods in static and dynamic structural analysis, including the principles of virtual displacements and virtual forces. Influence lines. Matrix analysis of structures, influence and stiffness coefficients. Computer facilities are used.

405. *Structural Design in Steel*
Fall, Winter. 4(4-0) 305.
Beams, columns, tension and compression members, connections. Elastic, plastic and ultimate strength concepts.

406. *Structural Design in Concrete*
Winter, Spring. 4(4-0) 305.
Reinforced concrete beams, columns, slabs, footings and retaining walls. Elastic theory and ultimate strength concepts. Prestressed theory and design.

407. *Structural Design Concepts*
Spring. 3(3-0) 405, 406.
Develop and expand design concepts through study, investigation and project design of various structural systems. Criteria for material selection and creative design of unusual structural systems pursued.

410. *Structural Mechanics III*
Fall. 4(4-0) 400.
Beam-columns, elastic buckling, thin-walled members. Elementary theory with special reference to structures. Elements of plates and shells. Introduction to inelastic behavior of structures.

419. *Soil Mechanics II*
Fall. 4(4-0) 312.
Foundation engineering. Immediate, consolidation, and secondary settlements; stress distribution in soil masses; lateral earth pressures on structures; bearing capacity if shallow foundations; introduction to stability analysis of earth structures.

421. *Hydrology*
Fall, Spring. 4(3-2) 280, 321, 390.
Engineering hydrology; frequency and precipitation analysis; streamflow analysis and the unit hydrograph; flood prediction; rainfall-runoff correlations; urban hydrology.

422. *Hydraulic Systems*
Winter. 4(3-2) 321, 390 or M E 351.
Steady flow in pipe networks; open channel flow; turbomachinery; groundwater hydraulics; introduction to unsteady flows. Applications to water supply systems; aquifer analysis; surges and water hammer.

441. *Highway Operations*
Spring. 3(3-0) 346 or 342.
Driver and vehicle characteristics affecting traffic flow; traffic flow density, headway and speed measurements; signing and signal control for efficient intersection operation, parking characteristics and capacity analysis.

442. *Airport Planning and Design*
Fall. 3(3-0) 346.
The planning and design of the components of the airport system including ground access facilities; aircraft characteristics; the air traffic control system; airport configuration; capacity analysis; management systems.

448. *Transportation Planning*
Winter. 3(3-0) 342 or 346.
Urban transportation facilities needs and programs. Design of transportation models for urban highways and public transit including trip generation, trip distribution, mode split and traffic assignment. Transport agencies function and services.

449. *Highway Engineering*
Spring. 3(2-2) 308, 347.
Design concepts of roadways, facilities, drainage and pavement design. Maintenance, construction and supervision methods and procedures.

471. *Scheduling Construction Activities*
(871.) Winter. 3 credits. Approval of department.
Techniques for coordinating and controlling construction projects. Scheduling under the constraints of deadlines, uncertain time estimates and limited resources. Computer programs and data files for effective management.

481. Water and Wastewater Analysis

(487.) Fall. 4(3-3) 280.

Quantitative analysis; bacteriologic and chemical characteristics of water and wastewater; principles of softening, iron removal, coagulation and chlorination; laboratory examination of water and wastewater including turbidity, solids, coliforms, chlorine, etc.

483. Water and Wastewater Treatment

Spring. 4(3-2) 280, 421, 422 or concurrently. Not open to graduate majors in sanitary engineering.

Water treatment theory and design including sedimentation, coagulation, softening, iron removal and chlorination; wastewater treatment theory and design including grit chambers, activated sludge, trickling filter, and anaerobic digesters.

485. Environmental Health Engineering

Winter. 3(3-0) MPH 200, C E 280.

Epidemiology of communicable disease transmitted by air, water, food and arthropods. Engineering measures to control disease spread. Incidence and prevalence rates, well design, cross-connections, disinfection, sanitary inspection. Case studies.

499. Civil Engineering Projects

Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 6 credits. Approval of department.

Original civil engineering problem of specific interest to the student and a faculty member. Student's proposal describing problem required prior to approval.

800. Operations Research Techniques for Civil Engineers

Fall. 3(3-0) Graduate standing.

Elements of deterministic methods of operations research with emphasis on computational techniques and applications to civil engineering problems such as structural design, water supply, transportation, and construction management.

802. Structural Dynamics I

Fall. 3(3-0) 405, 406, or approval of department.

Basic concepts in structural dynamics; dynamic loading on structures due to blasts and earthquakes; dynamic properties of structures; methods of analysis; design approach to blast and earthquake resistant structures; dynamic behavior of bridges and other topics.

804. Advanced Structural Theory I

Winter. 4(4-0) 400, or approval of department.

Energy principles and their application in the analysis of elastic structures. Advanced force and displacement methods and their matrix formulation. Introduction to finite element methods.

805. Advanced Theory of Reinforced Concrete I

Winter. 3(3-0) 406.

Deflection, torsion, shrinkage, plastic flow, and ultimate strength of concrete structures. Prestressed concrete.

807. Model Analysis

Fall. 3(2-3) 406.

Basic theory of the analysis of structures by means of models. Laboratory work on models; Begg's deformeter and electric resistance type gauges for the measurement of static and dynamic strains.

809. Finite Element Method

Spring. 3(3-0) Approval of department. Interdepartmental with the departments of Metallurgy, Mechanics and Materials Science and Agricultural Engineering and administered by the Department of Metallurgy, Mechanics and Materials Science.

Theory and application of the finite element method to the solution of continuum type problems in heat transfer, fluid mechanics and stress analysis.

815. Principles of Highway and Airport Soils

Winter. 4(4-0) 347.

Foundation problems as related to highways and airports, relation of subsoil conditions to design and construction, analytical review of laboratory and field results.

817. Mechanical Properties of Soils

Fall. 4(3-3) 419 or approval of department.

Mechanical properties of soil including stress-strain behavior; conditions of failure and shear strength; consolidation theory and permeability. Laboratory determination of soil properties including interpretation of experimental data for use in practice.

818. Advanced Soil Mechanics

Winter. 4(4-0) 419; 817 recommended.

Foundations and earth retaining structures; bearing capacity, lateral resistance and settlement of deep foundations; earth pressures on braced excavations and sheet pile walls; design of caissons and cofferdams.

819. Soil Stabilization in Geotechnical Engineering

Summer. 3(3-0) 419.

Techniques to improve the performance of soil in engineering applications; compaction, blending, admixture, grouting, electrosmosis, vibroflotation, compaction piles, thermal treatment, load bearing and hydraulic fills, precompression, reinforced earth.

820. Geotechnical Engineering for Cold Regions

Spring. 3(3-0) 419 or approval of department.

Physical and thermal properties of ice and frozen soils; ground thermal regime; mechanical properties of frozen ground; thaw consolidation problems; foundation design; slope stability problems; and artificial freezing for construction.

821. Flow of Fluids in Porous Media

Fall. 3(3-0) 422 or approval of department.

Structure and properties of porous media. Fluid flow in saturated and unsaturated media. Two-phase flow. Darcy's and Navier Stokes equations. Two-dimensional sink flow. Multiple sources and sinks. Potential theory and conformal mapping. Permeability in an anisotropic medium.

827. Environmental Fluid Mechanics

Spring of even-numbered years. 4(4-0) 422 or approval of department.

Review of turbulent flow and transport processes in water quality control. Analysis and solution of ecological problems related to diffusion and disposal in rivers, estuaries, lakes and the ocean environment.

828. Open Channel Flow

Winter. 3(3-0) 422 or approval of department.

Fundamentals of free surface flow; steady uniform and nonuniform concepts; energy and momentum principles; subcritical and supercritical regimes; gradually and rapidly varied flow; design applications.

829. Fluid Transients

Spring of odd-numbered years. 4(4-0) 828 or approval of department.

Application of unsteady flow concepts and wave mechanics to hydraulic engineering; method of characteristics; surges and waterhammer in piping systems; unsteady open channel flow; oscillatory waves; similitude and models. For students interested in fluid mechanics.

840. Pavement Design

Spring of even-numbered years. 3(3-0) 449.

Pavement types and wheel loads, stresses in flexible pavements, stresses in rigid pavements, pavement behaviors under loadings, climate effects on pavement performance, evaluating subsoil strengths, subgrades, and pavement design criteria.

841. Optimization of Urban Traffic Flow

Fall. 3(3-0) Approval of department. Interdepartmental with and administered by Systems Science.

Traffic flow models used in design of computerized traffic control systems. Optimal freeway ramp metering algorithms. Offline and online optimization of traffic signal timing.

842. Pavement Rehabilitation

Spring of odd-numbered years. 4(4-0) 449.

Strengthening existing pavements, pavement overlay design criteria, epoxy and polyester resin repair and rehabilitation, evaluation of resurfacing practices for bituminous and cement pavements.

843. Traffic Engineering Characteristics

Winter. 3(3-0) 346, STT 421.

Safety analyses, flow and capacity characteristics, statistical properties of traffic, queuing characteristics at intersections, delay characteristics and analyses.

844. Traffic Engineering Theory and Control

Spring. 3(3-0) 843.

Application of the theory of traffic flow to the design and control of traffic streams. Dispatching, scheduling and network analysis. Application to highways, airport operation and urban transportation modes.

845. Environmental Impacts of Transportation Facility Design Decisions

Spring. 3(3-0) 342 or 346, 448; or approval of department.

The context in which current transportation planning and design decisions are made; legislation; socio-economic effects; air, noise, and water pollution. Preparation of environmental impact statements.

846. Highway Planning

Fall. 3(3-0) 346 or approval of department.

Highway inventory, road use studies and programing, analysis of highway costs, economic considerations in location and design.

847. Geometric Design of Highways

Winter. 3(3-0) 346 or approval of department.

Design of streets and highways including intersections, parking facilities, capacity, channelization and roadway appurtenances.

848. *Transportation Models*

Spring. 3(3-0) 448.

Analysis of transportation modeling process, including error propagation and parameter sensitivity analysis. Comparative attributes of zonal size and model sequence decisions on the evaluation of system alternatives.

880. *Special Problems in Civil Engineering*

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

Research problems of limited scope not pertaining to thesis accomplished under 899 or 999.

899. *Research*

(EGR 899.) Fall, Winter, Spring, Summer. Variable credit. Approval of department.

905. *Advanced Theory and Design of Reinforced Concrete II*

Spring. 3(3-0) 805.

Continuation of 805 with application of theory to analysis and design of tanks, rigid frames, and shells.

906. *Advanced Structural Steel Design*

Spring. 3(3-0) 406.

Analysis and design of multiple-story building frames, continuous trusses and rigid-frame girder bridges in structural steel. Plastic design.

909. *Elastic Thin Shells*

Spring. 4(4-0) 804 or MMM 815 or approval of department; MTH 421. Interdepartmental with the Metallurgy, Mechanics and Materials Science Department.

Elements of differential geometry, membrane theory of shells, Pucher's stress function, deformation and bending of shells of revolution and shallow shells.

912. *Theory of Plates*

Winter. 4(4-0) 804 or MMM 815 or approval of department; MTH 422. Interdepartmental with and administered by the Metallurgy, Mechanics and Materials Science Department.

Bending of thin elastic plates with various shapes and boundary conditions; application of energy principles and approximate methods of solution; thick plates; large deflection theory; sandwich plates.

915. *Earth Structures*

Spring. 3(3-0) 817 or approval of department.

Embankments, earth dams, natural and cut slopes, stability of circular and composite slip surfaces; performance of embankments on soft foundations; seepage through earth dams; instrumentation for field performance evaluation.

916. *Soil Dynamics*

Winter. 3(3-0) 817 or approval of department.

Characteristics of ground motions during earthquakes; dynamic soil properties; liquefaction and settlement under transient and repeated loadings; foundation design for vibratory loads; wave propagation in soil media.

941. *Mass Transit Routing and Scheduling*

Fall of even-numbered years. 3(3-0) 848 or approval of department.

Routing algorithms for mass transit vehicles in urban networks; dispatching of vehicles by dynamic programming and other algorithms; variable headway, variable route transit system studies.

999. *Research*

(EGR 999.) Fall, Winter, Spring, Summer. Variable credit. Approval of department.

Sanitary Engineering S E

802. *Physical Chemical Processes of Environmental Engineering*

Fall. 4(3-3) C E 481 or concurrently.

Analysis of physical and chemical principles which form the basis of air and water pollution control and solid waste disposal; process dynamics, sedimentation, coagulation, filtration, adsorption, absorption, oxidation.

804. *Biological Processes of Environmental Engineering*

(906.) Winter. 5(4-3) MPH 200, C E 280, S E 802.

Aerobic and anaerobic degradation of liquid and solid wastes. Biochemical reactions; activated sludge and trickling filter kinetics; sludge digestion and composting.

812. *Water Treatment Plant Design*

(805.) Winter. 4(3-3) C E 370, 483, 828, S E 802.

Theory and design of water treatment processes. Coagulation and flocculation; softening; sedimentation; filtration; disinfection.

814. *Wastewater Treatment Plant Design*

(806.) Spring. 4(3-3) C E 370, 483, 828, S E 804.

Theory and design of wastewater treatment processes. Racks, screens, sedimentation basins, trickling filters, aeration tanks, digesters.

816. *Treatment of Industrial Wastes*

(803.) Spring. 3(3-0) 804.

Theory of industrial waste management. Application of physio-chemical and biological treatment to selected industries. Examples include: apparel; food processing; materials processing and chemical industry.

822. *Air Resource Management*

Fall of even-numbered years. 4(4-0) 802 or concurrently.

Characteristics of air contaminants and noise; sources and source inventory; microclimitology and pollutant transport; pollutant effects, introduction to sampling and control.

899. *Research*

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

922. *Air Pollution Control*

Winter of odd-numbered years. 4(3-3) C E 321; S E 802, 822.

Application of physical and chemical principles to control of gaseous and particulate air pollutants. Cyclones, bag houses, electrostatic precipitators, adsorption, absorption, combustion.

924. *Air Sampling and Analysis*

Spring of odd-numbered years. 4(3-3) 922.

Theory and design of air sampling programs. Quantitative analysis of ambient air samples and stack samples. Analysis for sulfur oxides, nitrogen oxides and particulates.

999. *Research*

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

CLASSICAL STUDIES

See Romance and Classical Languages

COMMUNICATION COM

College of Communication Arts and Sciences†

100. *Human Communication I*

Fall, Winter, Spring, Summer. 3(3-0)

Process and functions of communication. Principles underlying communication behavior. Practice in analyzing communication situations and in speaking and writing.

101. *Human Communication II*

Fall, Winter, Spring, Summer. 3(3-0) 100.

Continuation of 100, with greater emphasis on speaking and writing, and on analyzing increasingly complex communication situations.

199. *Methods of Inquiry*

Fall, Winter, Spring, Summer. 3(3-0) Majors and minors only. 101.

Major theoretic orientations toward communication. Primary tools of scholarly inquiry.

205. *Persuasion*

Fall, Winter, Spring, Summer. 4(4-0) 101.

Process of influencing human behavior through persuasive communication. Experience in creating persuasive messages and in evaluating the acceptability of persuasive attempts.

210. *Leadership*

Fall, Winter. 4(4-0) 100.

Principles and practice in the utilization of communication for effective leadership.

299. *Individual Projects*

Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 15 credits. 199, approval of project proposal by department.

Independent research, experience in communication laboratories, or tutorial work in communication skills.

300. *The Effects of Mass Commuunication I*

Fall, Winter, Spring, Summer. 4(3-0) Majors must enroll in 300R concurrently.

Major social effects of mass media on audience behavior. Political communication. Media effects on children. Message strategies producing attitude change. Interrelationship between mass media and interpersonal communication. Decision making in mass media.

300R. *Effects of Communication II*

Fall, Winter, Spring, Summer. 1 credit. Majors. 300 concurrently.

In-depth consideration of effects of communication.

315. *Organizational Communication*

Spring. 4(4-0) 101.

Principles and practice in the management of communication systems, with emphases on conflict resolution, information exchange, innovativeness, and information management.

†Name changed effective July 1, 1975. Formerly College of Communication Arts.