ENGINEERING (CORE COURSES)

INTRODUCTION

Engineering graduate programs require the study of some of the following general (core) graduate engineering courses.

0600-503	Statistical Concepts in Engineering	(3)
0600-504	Numerical Analysis and Computation	(3)
0600-505	Finite Element Methods	(3)
0600-506	Continuum Mechanics	(3)
0600-507	Mathematical Optimization	(3)
0600-508	Random Variables and Stochastic Processes	(3)
0600-510	Advanced Fluid Mechanics	(3)
0600-511	Computational Fluid Dynamics	(3)
0600-512	Advanced Engineering Mathematics I	(3)
0600-513	Advanced Engineering Mathematics II	(3)

COURSE DESCRIPTION

0600-503: STATISTICAL CONCEPTS IN ENGINEERING
CR: 3

Elements of probability theory, random variables, analytical models of random phenomena, reliability, factor of safety, safety margin, extreme value statistics, Monte-Carlo simulation, empirical determination of distribution models, confidence intervals, regression and correlation analysis, general applications to engineering design problems, stochastic processes.

0600-504: NUMERICAL ANALYSIS AND COMPUTATION
CR: 3

Norms, limits and condition numbers. Inverses of perturbed matrices. Integrative techniques for solving systems of equations. The LU, QR and singular value decompositions. Algorithms for the linear least squares and linear minimax problems. Computation of the eigenvalues of a matrix. the interpolation and polynomial approximation. Approximate methods for initial value problems and for boundary value problems.

0600-505: FINITE ELEMENT METHODS
CR: 3

Origin and basis of finite-element methods in continuum mechanics, stiffness method, assumed displacement field, potential energy and Rayleigh-Ritz method, types of elements, modeling, accuracy and convergence, solution techniques and computer application to structural and fluid mechanics.

0600-506: CONTINUUM MECHANICS
CR: 3

Cartesian tensors. Basic principles of continuum mechanics: deformation, displacement, strain, stress, conservation of mass, continuum thermodynamics and constitutive equations. Illustrative applications in elasticity, fluid dynamics, viscoelasticity ad plasticity.

0600-507: MATHEMATICAL OPTIMIZATION
CR: 3

Basic Concepts: The gradient vector and the Hessian Matrix, multidimensional Taylor's theorem, linear and quadratic approximation of a function. Unconstrained optimization, necessary

and sufficient conditions for optimality. Algorithms for single variable minimization, the Fibonacci search and the Golden section search, algorithms that use repeated polynomial interpolation. Algorithms for multi-dimensional minimization; The steepest descent, the Newton method and its variations, conjugate gradient algorithms such as the Flecter-Reeves, Polak and Ribieve, Quasi-Newton Methods such as the DEP-BFGS, Huang's family of algorithms. Constrained optimization: Necessary and sufficient conditions for constrained minima. Algorithms for constrained optimization: interior and exterior penalty function methods, augmented Lagrangian methods, Resen's gradient projection.

0600-508: RANDOM VARIABLES AND STOCHASTIC PROCESSES
CR: 3

Introduction to probability theory and engineering applications of probability. random variables and expected values. distribution of functions of random variables and applications of R.V. to system problems. Stochastic processes, correlation and power spectra, systems and random signals. Engineering decisions and estimation theories.

0600-510: ADVANCE FLUID MECHANICS
CR: 3

Motion of ideal, Newtonian, and non-Newtonian single-phase fluids. Continuity and Navier-Stokes equations for one and two dimensional flows. Turbulence and boundary layer theories. Flow through conduits, and porous medium. Homogenous and non-homogenous multiphase flow systems.

600-511: COMPUTATIONAL FLUID DYNAMICS
CR: 3

This course introduces students to the numerical and computational fluid dynamics. It will provide graduate students (Science and Engineering students) with techniques and approaches to solve numerical fluid mechanics problems encountered in real fluid flows. Methods for boundary layers, incompressible viscous flows, and inviscid compressible flows are studied. Finite differences and finite volume techniques are emphasized. The course utilizes using commercial CFD packages and MATLAB to solve fluid flow problems.

0600-512: ADVANCED ENGINEERING MATHEMATICS I
CR:3

Analytic function, residues, contour integration. Power series solutions of ordinary differential equations: Bessel's, Legendre's, Chebysheve's and Laguerre's functions. Matrix algebra eigenvalues, eigen-functions, and solutions of systems of differential equations. Software applications.

0600-513: ADVANCED ENGINEERING MATHEMATICS II
CR:3 PR:0600-512

Sturm-Liouville problem. Partial differential equations: Characteristic curves, separation of variables and integral transforms (Laplace and Fourier), method of characteristics. Wave, heat and diffusion-equations. Software applications.

MASTER OF SCIENCE
CIVIL ENGINEERING
Program code: 0620

INTRODUCTION

The Department of Civil Engineering (College of Engineering and Petroleum) offers a Master of Science program in **Civil Engineering**. Research requirements include either thesis or non-thesis options. The program is intended as a means of developing closer affinity to basic research and solving applied problems. The philosophy of the program reflects an interdisciplinary nature and embodies flexibility and choice variation to suit a multitude of needs. The Department of Civil Engineering offers courses and research opportunities in the following fields: Water Resources and Environmental Engineering, Construction Management, Geotechnical Engineering, Transportation Engineering, Structural Engineering. English is the Language of instruction and research. The program offers both thesis and non-thesis options.

According to the University Council decision dated 4/2/2007, Thesis students admitted with effect from September 2007 are exempted from the comprehensive examination.

PROGRAM REQUIREMENTS

33 (33) TOTAL COURSE CREDITS(non-thesis option in parenthesis)

6 (6) CORE ELECTIVE COURSES (3 credits each)

- 0600-503 Statistical Concepts in Engineering
- 0600-504 Numerical Analysis and Computation
- 0600-505 Finite Element Methods
- 0600-506 Continuum Mechanics
- 0600-507 Mathematical Optimization
- 0600-508 Random Variables and Stochastic Processes
- 0600-510 Advanced Fluid Mechanics
- 0600-511 Computational Fluid Dynamics
- 0600-512 Advanced Engineering Mathematics I
- 0600-513 Advanced Engineering Mathematics II

12 (12) SUBDISCIPLINE ELECTIVE COURSES (3 credits each)

Student select all 12 credits from one of the following five sub-disciplines. This sub-discipline is the specialty of the student's thesis or project.

I. WATER RESOURCES COASTAL AND ENVIRONMENTAL ENGINEERING:

0620-510 Transport Processes
0620-511 Ground water Hydrology
0620-512 Coastal Hydromechanics
0620-513 Sediment Transport
0620-514 Coastal Engineering
0620-516 Unsteady Open Channel Flow
0620-517 Hydrology
0620-520 Chemical and Biological Aspects of Environmental Engineering
0620-521 Unit Operations and Processes of Environmental Engineering I OR
2040-526 Environmental Engineering Processes
0620-522 Unit Operations and Processes of Environmental Engineering II
0620-524 Solid Waste Management
0620-525 Environmental Management and Impact Assessment OR
2040-504 Environmental Impact Assessment (EIA)
0620-526 Water Quality Modeling
0620-529 Special Topics in Water Resources and Environmental Engineering
0640-552 Waste Minimization
0640-557 Industrial Water Treatment

II. CONSTRUCTION MANAGEMENT

0620-530 Construction Management and Project Control
0620-532 Human Factors in Construction Engineering and Management
0620-533 Project and Company Organization in Construction
0620-534 Cost Management in Construction and Engineering Projects
0620-535 Construction Administration
0620-536 Decision Analysis in Construction
0620-537 Advanced Information Technology in Construction
0620-538 Advanced Building Construction Seminar
0620-540 Value Engineering
0620-541 Engineering and Construction Law

III. GEOTECHNICAL ENGINEERING

0620-550 Soil Dynamics
0620-551 Rock Mechanics
0620-552 Stability of Slopes
0620-553 Geotechnical Aspects of Landfill Design
0620-555 Advanced Soil Mechanics
0620-556 Ground and Site Improvement Techniques
0620-557 Theoretical Soil Mechanics

IV. TRANSPORTATION ENGINEERING

0620-560 Land-Use Analysis in Transportation
0620-561 Public Transportation Planning and Operation
0620-562 Transportation Systems Management
0620-563 Airport Planning and Design
0620-564 Pavement Management Systems
0620-565 Transportation Economics
0620-566 Traffic Control
0620-567 Transportation Demand Analysis and Forecasting
0620-568 Analytical Techniques In Transport Planning and Management
0620-569 Evaluation of Investments in Public Projects

V. STRUCTURAL ENGINEERING

0620-571 Structural Dynamics
0620-572 Design of Concrete Highway Bridges
0620-573 Finite Element Applications in Structural Analysis
0620-574 Inelastic Theory of Structural Design
0620-576 Structural Optimization
0620-577 Theory of Plates
0620-578 Reinforced Concrete
0620-579 Stability of Structures
0620-580 Analysis and Design of Wall Structures and Tall Buildings
0620-581 Special Topics in Structural Engineering
0620-582 Advanced Steel Design
0620-583 Advanced Topics in Reinforced Concrete Design
0620-584 Durability of Concrete Structures

6(12) FREE ELECTIVE COURSES

A maximum of 3 credit hours (thesis students) and 6 credits hours (project students) can be taken from **core engineering**, any other Engineering, Science, Computer Science, and engineering or joint graduate programs with the approval of the Graduate Program Director and Area Committee Chairman before registering the course. **Also, courses can be taken from the same graduate program course.**

9 (3) COMPULSORY

0620-592	Seminar	(0)
0620-593	Project	(3) (non-thesis option only)
0620-597	Thesis	(0)
0620-598	Thesis	(0)
2000-599	Thesis	(9)

COURSE DESCRIPTION

0620-510: TRANSPORT PROCESSES
CR: 3

Transport processes in water, turbulent diffusion and longitudinal dispersion in rivers and estuaries, mixing, transport of pollutants, self purification and waste assimilation capacity, thermal pollution, receiving water quality.

0620-511: GROUND WATER HYDROLOGY
CR: 3

Ground water and aquifers, well-flow systems, measurement of aquifer parameters, modeling of aquifer systems, surface-subsurface water relations, subsidence and lateral movement of land surface due to pumping.

0620-512: COASTAL HYDROMECHANICS
CR: 3

Fundamentals of fluid flow, small amplitude wave theory, waves of finite height-Stokes theory, solitary wave, wave propagation and refraction in water of variable depth, wave generation and forecasting techniques, statistical models for ocean waves, long period waves, linear shallow water wave theory, tidal flows, harbor oscillations, basic theory and analysis of harbors of various shapes.

0620-513: SEDIMENT TRANSPORT
CR: 3

Sediment properties, initiation of sediment motion, suspended load, bed load, total sediment load, bed forms, resistance of movable beds, flow in alluvial channels, stability to alluvial channels, aggradation and degradation, instrumentation and measuring techniques, modeling of fluvial processes, reservoir sedimentation, sediment transport in closed conduits.

0620-514: COASTAL ENGINEERING
CR: 3

Introduction to coastal engineering, coastal environment and coastal structures. Fundamental properties of waves, tides and tidal currents, their analysis, predictions and transformations. Short- and long-term wave analysis, and design waves. Coastal structures: types, functionality, limitations, and design factors. Waves. forces and moments on structures: interia/drag forces and moments; breaking, broken, and non-breaking wave forces and moments. Design of coastal structures: design water levels and wave heights; siting and layout; design of seawalls, breakwaters and groins. Design considerations for harbors and marinas. Modeling and scaling laws in coastal engineering.

0620-516: UNSTEADY OPEN CHANNEL FLOW
CR: 3

Review of basic concepts of steady uniform flow, the energy and momentum concepts in open channel, flow resistance for uniform and non-uniform flow conditions, gradually varied flow, rapidly varied flow, spatially varied flow, gradually varied unsteady flow, rapidly varied unsteady flow, spatially varied unsteady flow, flood routing, channel routing, reservoir routing, method of characteristics, finite difference formulation, computer applications.

0620-517: HYDROLOGY
CR: 3

Hydrologic proccesses, precipitation, evaporation, transpiration, infiltration, stream flow, hydrograph analysis, flood routing, urban hydrology, statistical concepts and stochastic hydrology, hydrologic design.

0620-520: CHEMICAL AND BIOLOGICAL ASPECTS OF ENVIRONMENTAL ENGINEERING
CR: 3

Principles of water chemistry: chemical equilibrium; acid-base reactions; oxidation-reduction reaction; colloidal system; chemical precipitation. Basic concepts from Water Microbiology: microbial growth; aquatic food chains; indicator organisms. Water and Wastewater analysis. Water quality standards. Fundamentals of process kinetics: reaction; catalysis, materials balance, biological kinetics.

0620-521: UNIT OPERATIONS AND PROCESSES OF ENVIRONMENTAL ENGINEERING I
CR: 3

Theory and application of biological treatment methods, microbiological fundamentals, process kinetics and reactor design, suspended and attached growth systems, aerobic and anaerobic processes, oxygen transfer, soil systems, sludge processing. Laboratory assignments and design projects for selected unit processes.

0620-522: UNIT OPERATIONS AND PROCESSES OF ENVIRONMENTAL ENGINEERING II
CR: 3

Reactor dynamics and mass transport processes; theory and design of treatment systems for phase and species transformation processes, particulate separation processes, and solute separation processes; laboratory assignments and design projects for selected unit processes.

0620-524: SOLID WASTE MANAGEMENT
CR: 3

Solid waste generation, handling, storage, collection, transfer and transport, processing techniques and ultimate disposal. Engineering systems for materials and energy recovery. Administration of solid waste systems.

0620-525: ENVIRONMENTAL MANAGEMENT AND IMPACT ASSESSMENT
CR: 3

Examination of alternative choices for the management of environmental problems. Ecological systems, natural processes, data analysis. Legal, economic and planning techniques. Decision making, measurements of benefits and costs, normative evaluation techniques, environmental risk analysis. Preparation of environmental impact statements. Lectures and seminars are presented by staff, visiting speakers and students and case studies are discussed.

0620-526: WATER QUALITY MODELING
CR: 3

Comprehensive overview of transport and fate of pollutants in natural surface waters. An introduction to modeling fundamentals along with in-depth descriptions of how a variety of pollutants move and react within a variety of water bodies. A coverage of advanced modeling topics such as protozoan pollution and sediment processes.

0620-529: SPECIAL TOPICS IN WATER RESOURCES AND ENVIRONMENTAL ENGINEERING
CR: 3

An upper division of graduate technical elective treating topics in Engineering mostly not covered in other courses, chosen at the discretion of the Graduate Program Committee.

0620-530: CONSTRUCTION MANAGEMENT AND PROJECT CONTROL
CR: 3

Introduction to construction management concept, analytical techniques for bringing a project to completion within budget, on time and according to the specifications, including study of cost engineering and control, schedule and resource control, procurement and quality control.

0620-532: HUMAN FACTORS IN CONSTRUCTION ENGINEERING AND MANAGEMENT
CR: 3

Seminar dealing with the problems of working and communicating with individuals and groups.

0620-533: PROJECT AND COMPANY ORGANIZATION IN CONSTRUCTION
CR: 3

A survey of classical and modern organization theory; concepts and functions of management, the

behavior of the individual, the work group, and the organization, all linked to construction problems.

0620-534: COST MANAGEMENT IN CONSTRUCTION AND ENGINEERING PROJECTS
CR: 3

Introduction to cost estimating, cost budgeting, cost accounts, CPM cost loading, cost controlling, cost forecasting, and cost accounting of construction and engineering projects. The course also covers feasibility studies, level of influence, cost engineering, cost optimization, cash-flow analysis, cost-schedule compression, and life cycle costing.

0620-535: CONSTRUCTION ADMINISTRATION
CR: 3

Business and management aspects of construction: Kuwait industry profile, company organization, contracting methods, bonding and insurance, subcontracts, cash flow, and markup.

0620-536: DECISION ANALYSIS IN CONSTRUCTION
CR: 3

Procedures for deciding under uncertainty. Fundamentals of the expected-utility rule with personal subjective probabilities. Current applications of decision analysis. Analysis of problems using decision trees that include risk and time preference. Determination of the economic value of perfect and imperfect information on one or several variables in a decision problem.

0620-537: ADVANCED INFORMATION TECHNOLOGY IN CONSTRUCTION
CR: 3

Database management systems. Objective-oriented programming. Expert systems and artificial intelligence. Decision support systems.

0620-538: ADVANCED BUILDING CONSTRUCTION SEMINAR
CR: 3

Seminar dealing with the problems of building construction. Subjects include search patterns and sortation, standard specifications and control, systems safety, insurance and risk management, materials and workmanship, R&D activities, technological adaptation, development of indigenous capabilities and requirements of the construction industry.

0620-540: VALUE ENGINEERING
CR: 3

Systematic approach to control the quality and performance of engineering projects while maintaining minimum costs. Real projects are studied by multi-disciplinary groups working in teams to specify the real value of the project.

0620-541: ENGINEERING & CONSTRUCTION LAW
CR: 3

Contract planning, construction procurement and contract negotiations, contract formation and agreement, contract administration and management. Change orders administration, types of claims and disputes, claims analysis, evaluation and resolution. Alternative dispute resolution (ADR), Litigation and arbitration.

0620-550: SOIL DYNAMICS
CR: 3

Introduction to soil dynamics, review of linear vibration theory, earthquake engineering, dynamic soil properties, response analysis and response spectra, liquefaction, settlement, foundation design for vibratory loads, isolation of foundation.

0620-551: ROCK MECHANICS
CR: 3

Behavior and properties of rock as an engineering material, rock exploration, stress analysis in rocks, failure of rocks, design and construction of underground structures and slopes in rock, design of rock abutments for dams, engineering applications, laboratory and field rock testing techniques.

0620-552: STABILITY OF SLOPES
CR: 3

Shear strength of granular and cohesive soils, failure criteria in soils, lab/field tests selections, types of slopes failure, methods of analysis, slope stability of dams and embankments, infinite slope analysis, finite slope analysis, computer applications.

0620-553: GEOTECHNICAL ASPECTS OF LANDFILL DESIGN
CR: 3

The application of geotechnical engineering principles and methods to site selection and design of municipal solid waste landfills that include settlement analysis, slope stability, liner compaction, and leachate collection system, as they relate to designing a landfill. Computer software is used to assist in the design scenarios.

0620-555: ADVANCED SOIL MECHANICS
CR: 3

Consolidation theory and secondary compression. Settlement Analysis. Basic strength principles. Stress-strain-strength behavior of clays with emphasis on effects of sample disturbance, anisotropy and strain rate. Stress-strain-strength behavior of granular soils. Engineering properties of compacted soils. Laboratory on consolidation and strength testing.

0620-556: GROUND AND SITE IMPROVEMENT TECHNIQUES
CR: 3

Geotechnical properties of local soils (subsurface desert sand, cemented sand, coastal ground). Soil compaction. Subsurface water rise: causes and remedial measures. Slurry trench cutoffs. Soil grouting. Subsurface drainage of cohesive soils. Soil reinforcement. Preloading. Instrumentations. Case studies.

0620-557: THEORETICAL SOIL MECHANICS
CR: 3

Stress at a point. Strain at a point. Stress-strain relationships in linearly elastic materials. Basic equations of elasticity in solids. Critical state concepts. Plasticity . Basic formulation of viscoelastic materials. Viscoplasticity. Constitutive equations. Applications.

0620-560: LAND-USE ANALYSIS IN TRANSPORTATION
CR: 3

The urban system, urban activities and transport system, spatial interaction modelling, optimization models, econometric models, demographic models, intergrated urban systems modeling and policy analysis.

0620-561: PUBLIC TRANSPORTATION PLANNING & OPERATION
CR: 3

Public transportation system technologies, urban passenger transport modes, bus system, paratransit, planning public transportation systems, rural public transportation, comparing transit modes, management and operations of public transit systems, public transportation security and safety, environmental impacts of transit systems.

0620-562: TRANSPORTATION SYSTEMS MANAGEMENT
CR: 3

Establishment of goals and objectives of a transport system, the systems approach, methods of identifying available options for management of a transport system, control options versus non-control options, network flow optimization, flexible work hours, reversible lanes, priority assignment to high occupancy vehicles, road taxation, non-auto area restrictions, measures of effectiveness, option-packaging analysis, operations models, performance evaluation models.

0620-563: AIRPORT PLANNING AND DESIGN
CR: 3

Air travel demand-capacity analysis, planning and design of an airport, airport site selection, airsite activities and operations, land-side activities and operations, terminal and airfield designs, facility requirements and plans, environmental impacts of airport operations.

0620-564: PAVEMENT MANAGEMENT SYSTEMS
CR: 3

Basic components of pavement management, systems-evaluation of pavement performance, structural capacity, design objectives and constraints, alternative design strategies and applied economic evaluation techniques, analysis of predicting distress performance and selection of an optimal design strategy with respect to safety, implementation and feedback data systems, examples of working design and management systems.

0620-565: TRANSPORTATION ECONOMICS
CR: 3

Public systems evaluation, elements of supply and demand, economic equilibrium, investment criteria, vehicle operating costs. Value of travel time, accident costs. Consumer surplus in transportation, non-user impacts, evaluation methods of investments in transportation systems.

0620-566: TRAFFIC CONTROL
CR: 3

Traffic control system strategies. Off-line signal optimization and real-time traffic-responsive control techniques. Control methods for single intersections, arterial systems and area wide traffic network. Evaluation of traffic control systems using measures of effectiveness.

0620-567: TRANSPORTATION DEMAND ANALYSIS AND FORECASTING
CR: 3

The demand for transportation. The supply of transportation. Transportation cost and cost functions. Urban passenger travel demand. Intercity passenger travel demand. Air travel demand. Commodity transport demand.

0620-568: ANALYTICAL TECHNIQUES IN TRANSPORT PLANNING AND MANAGEMENT
CR: 3

Category analysis. General linear models. Linear models with transformation. Input--Output analysis. Cohort-Survival model. Multinomial logic models. Time-Series analysis. Simulation.

0620-569: EVALUATION OF INVESTEMENTS IN PUBLIC PROJECTS
CR: 3

Principles of engineering economic analysis, price theory and resource allocation, elements of supply, elements of demand, economic equilibrium, welfare economics, investment criteria, principles of benefit-cost analysis. A flood control example, a water pollution control example, a highway transport example, evaluation of large scale projects, other approaches to evaluation including rating scale and goal achievement methods and programming project investments. The course will include case studies from Kuwait and students will each conduct, present and submit a report describing an analysis of a public project in Kuwait.

0620-571: STRUCTURAL DYNAMICS
CR: 3

Numerical analysis of single degree elastic and inelastic systems, analysis of single degree elastic and elastoplastic systems, lumped-mass multidegree freedom systems, structures with distributed mass and loads, beams subject to moving loads, consistent mass method, continuous mass method, numerical applications.

0620-572: DESIGN OF CONCRETE HIGHWAY BRIDGES
CR: 3

Common types of concrete bridges, design loads, design of T-beam bridges, design of box-girder bridges, design of continuous prestressed concrete slab bridges with a variable cross-section (a haunched or parabolic soffit).

0620-573: FINITE ELEMENT APPLICATIONS IN STRUCTURAL ANALYSIS
CR: 3

Principles of structural mechanics, element properties, solution techniques and programming of the finite element method, analysis of framed structures, three-dimensional stress analysis, analysis of plate bending, analysis of shells, formulation for dynamic analysis, formulation for instability analysis.

0620-574: INELASTIC THEORY OF STRUCTURAL DESIGN
CR: 3

Shear-friction concept, design of deep beams, design of brackets and corbels, torsional strength by the spacetruss analogy approach, limit design method, rotation capacity of concrete plastic hinges, columns subjected to biaxial bending, yield-line theory of slabs, strip method for slab design, design of earthquake-resistant structures.

0620-576: STRUCTURAL OPTIMIZATION
CR: 3

Applications of mathematical programming in design and analysis of trusses, beams, frames, and other structures. Optimization by calculus of variation and optimal control theory.

0620-577: THEORY OF PLATES
CR: 3

Classical theory for bending of plates of various shapes. Numerical methods in analysis of plates, goemetric properties of shells. Curvilinear coordinates, Membrane theory. Analysis of shells of revolution, Bending theory, Introduction to theory of thick plates.

0620-578: REINFORCED CONCRETE
CR: 3

Design of Slab-girder type bridges, design of industrial buildings, roofs, composite construction, arches, crane girders, transverse frames, design of circular and rectangular tanks, shell roofs and folded plates.

0620-579: STABILITY OF STRUCTURES
CR: 3

Eccentric compression of slender columns, beam-columns, lateral buckling of beams, buckling of thin plates, introduction to stability of shells.

0620-580: ANALYSIS AND DESIGN OF WALL STRUCTURES AND TALL BUILDINGS
CR: 3

Definition and Design Criteria of Tall Buildings, General Planning Considerations, Vertical Load Analysis, Calculation of Lateral Wind and Earthquake Loads, analysis of Frames; Shear Walls; Shear Wall-Frame Structures, Lateral Load Distribution, Design Consideration of Reinforced Concrete Frames, Shear Walls and Reinforced Masonry Shear Walls, Computer Applications.

0620-581: SPECIAL TOPICS IN STRUCTURAL ENGINEERING
CR: 3

An upper division of graduate technical elective treating topics in Engineering mostly not covered in other courses, chosen at the discretion of the Graduate Program Committee.

0620-582: ADVANCED STEEL DESIGN
CR: 3

Built-up sections, design of plate girders, composite (steel and concrete) design, building connections, design of multi-story buildings, design of simply supported bridges.

0620-583: ADVANCED TOPICS IN REINFORCED CONCRETE DESIGN
CR:3

Slab design by the strip method and yield line theory, slenderness effects in long columns, design of combined footings, cantilever footings, pile foundations, and retaining walls, design for torsion.

0620-584: DURABILITY OF CONCRETE STRUCTURES
CR: 3

Factors essential to the enhancement of durability of concrete and structures, designing for durability according to macro and micro climatic conditions, role of supplementary cementitious materials, super plasticizers, corrosion inhibitors, polymers, fibres and structures. Design and use of high strength lightweight concrete for off shore structures. Durable concrete repair.

0620-592: SEMINAR
CR:0

Following the directions of the graduate program committee related to the project.

0620-593: PROJECT
CR: 3

0620-597: THESIS
CR: 0

0620-598: THESIS
CR: 0

2000-599: THESIS
CR: 9