

## STUDY PLAN

### PhD. IN (Civil Engineering/Structures) (Thesis Track)

Plan Number		2005
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#### I. GENERAL RULES CONDITIONS:

1. These Requirements shall conform with the regulations of the general frame of the program of Graduate Studies.
2. Background requirements for Ph.D. program:
  - Master Degree in Civil Engineering / Structures

#### II. SPECIAL CONDITIONS:

The teaching language of the program is English

#### III. THE STUDY PLAN : Studying ( 54) Credit Hours as follows:

##### 1. Obligatory courses: (18) Credit Hours:

Course No.	Course Title	Credit hrs.	Theory	Prac.	Pre-request
0901931	Structural Stability	3	3	-	-
0901932	Finite Element Methods	3	3	-	-
0901933	Plates and Shells	3	3	-	-
0901934	Limit Analysis of Structures				
0901935	Non-linear Structural Analysis	3	3	-	-
0901936	Reinforced Concrete Slabs	3	3	-	-

##### 2. Elective Courses: Studying (18) Credit hours from the following:

Course No.	Course Title	Credit hrs.	Theory	Prac.	Pre-request
0901937	Advanced Structural Dynamics	3	3	-	-
0901938	Reliability in Structural Engineering	3	3	-	-
0901939	Energy Methods and Elasticity	3	3	-	-
0901940	Concrete Technology	3	3	-	-
0901941	Rehabilitation of Structures	3	3	-	-
0901942	Advanced Geotechnical Engineering	3	3	-	-
0901943	Advanced Finite Element Methods	3	3	-	-
0901991	Special Topics in Civil Engineering	3	3	-	-

**3. Pass the qualifying Exam: (0901998)**

**4. Dissertation: (18) Credit hours (0901999)**  
**Course Description**

**0901931 Structural Stability (3 credit hours)**

Equilibrium paths and critical points, bifurcation and energy approach. Elastic and inelastic buckling of columns, stability functions, coupled buckling modes. stability of structural systems by matrix formulation, 3D analysis of line elements, flexural torsional buckling, lateral torsional buckling, plate buckling, post buckling behavior.

**0901932 Finite Element Methods (3 credit hours)**

Theory of finite element, formulation for frame, plane stress, plane strain, axisymmetric and solid elastic elements, isoparametric formulation and implementation, plate and shell elements, application of the method using ready software packages.

**0901933 Plates and Shells (3 credit hours)**

Bending theory of rectangular and circular thin plates, plates on elastic subgrade, contact pressure. Introduction to shell theories, membrane theory of shells of revolution, bending theory of shells of revolution loaded axisymmetrically, membrane theory of cylindrical shells, analysis of shallow spherical shells.

**0901934 Limit Analysis of Structures (3 credit hours)**

Introduction to Theory of Plasticity. Failure criteria. Limit analysis theorems; lower bound, upper bound, and uniqueness. Application in one-dimensional steel elements, trusses, beams, beam-columns, and frames. Extension to two-dimensional elements (plates). Mechanisms, deflection, and second-order effect at ultimate state.

**0901935 Non-linear Structural Analysis (3 credit hours)**

Material and geometric nonlinearity, iteration strategies including secant, initial stress and Newton-Raphson, step-by-step application for dynamic loads. P-delta analysis, stability analysis of global structures, elasto-plastic analysis of frames.

**0901936 Reinforced Concrete Slabs (3 credit hours)**

Yield-line analysis, Nichols' derivation of static moment, Westergaard's distribution of bending moments in elastic plates, finite-difference, informal methods of analysis: direct-design method, equivalent-frame method, strip method, deflected shape of plates, shear strength of column-slab connections, effect of openings near columns, lateral loading.

- 0901937 Advanced Structural Dynamics (3 credit hours)**  
Distributed parameter systems, wave propagation analysis, nonlinearity and instability in dynamic analysis, linear and non-linear analysis of earthquakes in time and frequency domains, random vibrations, soil-structure interaction, fluid-structure interaction.
- 0901938 Reliability in Structural Engineering (3 credit hours)**  
Analysis and specifications of structural performance using probabilistic and statistical methodology, reliability of single member under single action, reliability of multi-member systems under multiple loads, matrix reliability analysis, approximate methods of reliability analysis, probability based design methods, application of computer simulation.
- 0901939 Energy Methods & of Elasticity (3 credit hours)**  
Introduction of Fundamental Variational Principles. Work and complementary Work. Strain energy and complementary strain energy. Virtual work and Castigliano's theorems. Variational methods. Resissner's and Hamilton's principles. Applications to the formulation of governing differential equations and boundary value problems in elasticity. Selected topics in energy methods and elasticity.
- 0901940 Concrete Technology (3 credit hours)**  
Knowledge of physical and chemical properties of fresh and hardened concrete in relation to strength and durability, mix-design of high-strength concrete, use of concrete admixtures, examination of special concreting practices in hot and cold environments, identification of concrete deterioration mechanisms and control, review of repair materials and techniques, development of shotcrete and other special concretes with blended cements, polymers and fiber reinforcement.
- 0901941 Rehabilitation of Structures (3 credit hours)**  
Develops the concept of structural rehabilitation with emphasis on condition assessment of existing structures and selection of repair and strengthening techniques, examination of structures damaged by settlement, overloading, corrosion, fire, earthquakes and design and construction errors, critical review of methods to restore/improve strength, durability and performance including foundation underpinning, beam and columns encasement, shotcreting, crack injection, corrosion control and seismic retrofitting.
- 0901942 Advanced Geotechnical Engineering (3 credit hours)**  
Composition, structure, and engineering behavior of claysoils, shear strength of cohesive and granular soils, Improvement of soils by compaction, drainage, and use of admixtures, seepage, erosion, and designal filters. Soil Dynamics, blasting.
- 0901943 Advanced Finite Element Methods (3 credit hours)**

Advanced theory and applications of the finite element method, as needed for research in computational science and engineering. Finite element methods for parabolic and hyperbolic problems; mixed finite-element methods; and applications to systems of equations. Applications to mechanics of solids (e.g. curved, plate, and shell elements), fluids, and thermal problems. Nonlinear element formulation with application to material and geometric non-linearities; stability problems; formulation and solution of problems in structural dynamics. Computer program formulation and use of commercial software products. Other advanced topics (e.g., Locking, boundary elements, edge elements, mesh-free methods, adaptive analysis, wave propagation problems, etc.), depending on mutual interest between students and instructor.

**0901991 Special Topics in Civil Eng.**

**(3 credit hours)**

Structured presentation of new and developing areas of knowledge in civil engineering offered by the faculty in their specialized areas of expertise to augment the formal courses available.