NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF CIVIL ENGINEERING

CIVIL ENGINEERING PROGRAM

SYLLABUS - STRUCTURAL ANALYSIS II

I. GENERAL INFORMATION

CODE	**:**	EC213
SEMESTER	**:**	10
CREDITS	**:**	4
HOURS PER WEEK	**:**	6 (Theory – Practice)
PREREQUISITES	**:**	EC211 Structural Analysis I
CONDITION	**:**	Elective
INSTRUCTOR	**:**	Hugo Scaletti
INSTRUCTOR E-MAIL	**:**	scaletti@alum.mit.edu

II. COURSE DESCRIPTION

This course provides students with fundamental principles of the Matrix Analysis of structures and its application to bar structures. Its general objective is the understanding of the concepts on which computational techniques used in structural analysis are based and their application through manual procedures using calculators and student versions of commercial programs as well as the analysis of the results obtained.

III. COURSE OUTCOMES

1. Apply methods and techniques common in Civil Engineering for formulating and solving problems of the specialty.
2. Use specialized software to perform his/her work.
3. Interpret results of the structures behavior from the laws which determine them.
4. Mathematically represent the structural analysis of civil engineering problems, and carry out the respective modeling and analysis.
5. Analyze and design reticulated structures.
6. Analyze and design portico-type structures.

IV. LEARNING UNITS

1. ANALYSIS OF RETICULATEDSTRUCTURES

Plane and spatial reticulated structures / Assumptions and simplifying assumptions / Rigidity of 2D and 3D bi-articulated bars / Analysis of reticulated structures with concentrated loads / Temperature increments / Initial deformations / Algorithms and programs for analyzing reticulated

2. ANÁLYSIS OF PORTICO-TYPE STRUCTURES

Rigidity and flexibility of 2D beam-column elements / Shear deformation / Translation and rotation of reference system / Consideration for distributed forces / Genera 3D case / Simplifying hypothesis.

3. ADDITIONAL TOPICS IN THE ANALYSIS OF PORTICO-TYPE STRUCTURES
Portico-type structures with plates / Rigidity of elements with rigid arms / Embedded forces / Comparison of results with different hypothesis / Static and dynamic considerations / Elements with articulated borders / Substructures / Elements with varying section and/or curve axis.

4. SEISMIC ANALYSIS WITH EQUIVALENT STATIC FORCES
Lateral rigidity of a leveled portico / Approximations for modeling / Close coupling modeling / Wall lateral rigidity / Seismic analysis with tridimensional models / Rigid diaphragms / Comparison of results with different hypothesis.

5. INTRODUCTION TO FINITE ELEMENTS
Principle of virtual work / Potential energy / Rigidity and statically equivalent forces / Simple finite elements / Consistency, continuity and convergence / Iso-parametric elements / Practical considerations / Analysis of slaps with transversal loads.

6. INTRODUCTION TO NONLINEAR ANALYSIS
Nonlinear behavior, analysis and design / Geometric nonlinearities / Tensed structures / Moments magnification / Hypothesis of plastic patella / Seismic isolators and viscous dampers.

VI. METHODOLOGY

The course is carried out in theory and practice sessions, using active methods in the learning and teaching process, encouraging students' participation. The instructor exposes and gives examples to complement students' activities, using the available audiovisual aids. Students complete design projects.

VII. EVALUATION FORMULA

The average grade PF is calculated as follows:

PF = 0.33 EP + 0.33 EF + 0.16 PP + 0.17 TE

EP: Mid-Term Exam
EF: Final Exam
PP: Average of three quizzes
TE: Average of four design project reports

VIII. BIBLIOGRAPHY

1. **MC GUIRE, William, GALLAGHER, Richard y ZIEMIAN, Ronald**
   Matrix Structural Analysis
   John Wiley and Sons, N.Y., 2000

2. **TENA, Arturo**
   Structures Analysis Using Matrix Methods
   Limusa Editorial, México, 2004

3. **JAVIER PIQUÉ AND HUGO CALETTI**
   Building Seismic Analysis
   CIP – Chapter of Civil Engineering. Lima, 1991

IX. COURSE CONTRIBUTIONS TO STUDENT OUTCOMES ATTAINMENT

Course contributions to Student Outcomes are shown in the following table:

K = Key **R** = Related **Empty box** = Does not apply

	Outcome	Contribution
Engineering Design	Design civil works satisfying requirements and needs as well as given constraints and limitations.	**K**
Problem solving	Identify, formulate and solve engineering problems properly using the methods, techniques and tools of civil engineering.	**K**
Sciences Application	Apply the knowledge and skills of mathematics, sciences and engineering to solve civil engineering problems.	**K**
Experimentation	Conceive and conduct experiments, analyze data and interpret results	
Modern Engineering	Use and apply techniques, methods and tools of modern engineering necessary for the practice of civil engineering.	**R**
Engineering Impact	Understand the impact of engineering solutions on people and society in local and global contexts.	**R**
Project Management	Plan and manage civil engineering projects taking into account efficiency and productivity criteria.	**R**
Environmental Appraisal	Takes into account the importance of preserving and improving the environment in the development of their personal and professional activities.	**R**
Lifelong Learning	Recognize the need to keep their knowledge and skills up to date according to advances of civil engineering and engage in lifelong learning.	**R**
Contemporary Issues	Know and analyze relevant contemporary issues in local, national and global contexts.	**R**
Ethics and Professional Responsibility	Evaluate their decisions and actions from a moral perspective and assume responsibility for the executed projects.	**R**
Communication	Communicate clearly and effectively in oral, written and graphical formats, interacting with different types of audiences.	**K**
Teamworking	Appraise the importance of teamworking and participate actively and effectively in multidisciplinary teams.	**K**