



NATIONAL UNIVERSITY OF ENGINEERING COLLEGE OF CIVIL ENGINEERING

CIVIL ENGINEERING PROGRAM

SYLLABUS - STRUCTURAL ANALYSIS I

I. GENERAL INFORMATION

CODE	: EC211
SEMESTER	: 7
CREDITS	: 5
HOURS PER WEEK	: 6 (Theory – Practice)
PREREQUISITES	: EC122 Strength of Materials II
CONDITION	: Compulsory
DEPARTMENT	: Structures
INSTRUCTOR	: Luis Vargas, Edgar Valcarcel, Jorge Olarte, Patricia Gibu
INSTRUCTOR E-MAIL	: pgibu@uni.edu.pe

II. COURSE DESCRIPTION

This course trains students on the principles of the relationship between structures analysis and design, the analysis of displacements of several types of structures as a response to several solicitation applying energy methods for the solution to isostatic and hyperstatic structures. It deals with topics such as axial solicitations of bending shear force and torsion in structures, and responses in terms of stress and strain. During the course, students become aware of the importance of learning the structures action and the loads function in structures and its analysis through the force method, Castigliano's second theorem and iterative method.

III. COURSE OUTCOMES

1. Identify the characteristics of several types of structures and value the rigor and the objectivity of the theories exposed in the course.
2. Apply the knowledge and skills in science and mathematics to solve problems.
3. Understand that the structures' analysis and design must go together in the activity of the civil engineer.
4. Analyze the adequate use of the fundamentals and relate different procedures of the structural analysis with the principles of the applied mechanics.
5. Adequately use materials, taking into consideration their characteristics of resistance and deformability.
6. Apply energy methods in the solution to problems of isostatic and hyperstatic structures, related to a certain type of solicitation or solicitations.

IV. LEARNING UNITS

1. STRUCTURES DETERMINATION AND STABILITY – STRAIN ENERGY / 18 HOURS

Stability: External, internal and general stability / Structures determination: External, internal and general for several types of structures / Structural Isostatic change: Forms of Isostatic change / Strain energy: Clapeyron's law / Strain energy for every concept: Application to several types of structures.

2. ENERGY METHODS FOR CALCULATING LINEAR AND ANGULAR DISPLACEMENTS / 15 HOURS

Castigliano's first theorem: Linear and angular displacements in structures due to normal force, shear force, bending and torsion / No-load point displacement / Unit load method: Displacements in arc, bar, composite and continuous structures / Applications to find linear and angular displacements / Betti's theorem and Maxwell's theorem.

3. FORCE METHOD (FLEXIBILITY METHOD) / 18 HOURS

Undetermined structures analysis / Force method: Method Expression / Applications in continuous, reticular and arc structures / Applications in arc, articulated, composite and continuous structures.

4. CASTIGLIANO'S SECOND THEOREM / 9 HOURS

Castigliano's second theorem: Explanation of the theorem / Application in undetermined structures: arc, articulated, composite and continuous.

5. CONTINUOUS STRUCTURES ANALYSIS / 9 HOURS

Main definitions / Angular deformation method: explanation and main equations: Fundamental hypotheses / Application to structures with mobile and revolving nodes / Symmetrical continuous structures.

6. MOMENT DISTRIBUTION METHOD / 5 HOURS

Moment distribution method / Applications to rigidly framed structures with mobile and revolving nodes / Applications to continuous structures with intermediate ball and socket joint.

7. KANI'S METHOD / 10 HOURS

Kani's method: fundamental equations for mobile and revolving nodes / Applications to continuous rigidly framed structures: Shear force and bending moment diagrams / Continuous structures with articulated elements / Analysis of continuous structures of various heights with bars embedment and articulation / Applications to continuous rigidly framed structures with lateral loads.

8. TAKABEYA'S METHOD

Fundamental equations / Applications / Scalar focus of the stiffness and flexibility methods.

VI. METHODOLOGY

The course is carried out in theory and practice sessions. In theory sessions, the instructor introduces the analysis and the deduction of various theories in the learning process where students participate either individually or in work groups to solve problems. The instructor exposes and gives examples to complement students' activity. Students' learning is complemented with papers and problems given by the instructor in the classroom. The instructor provides offprints about theory and the solutions to several formulated problems.

VII. EVALUATION FORMULA

The average grade PF is calculated as follows:

$$PF = 0.3 EP + 0.4 EF + 0.3 PP$$

EP: Mid-Term Exam

EF: Final Exam

PP: Average of six quizzes

VIII. BIBLIOGRAPHY

- 1. HIBBELER R.C.**
Structural Analysis
Prentice Hall Ed., 2003
- 2. KENNEETH M. LEET AND CHIA MING VANG**
Structural Analysis
Mc. Graw Hill Ed., 2006

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.	
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.	
Ethics and Professional Responsibility	Evaluate their decisions and actions from a moral perspective and assume responsibility for the executed projects.	
Communication	Communicate clearly and effectively in oral, written and graphical formats, interacting with different types of audiences.	
Teamworking	Appraise the importance of teamworking and participate actively and effectively in multidisciplinary teams.	