NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF CIVIL ENGINEERING

CIVIL ENGINEERING PROGRAM

SYLLABUS - STEEL AND WOOD DESIGN

I. GENERAL INFORMATION

CODE	**:**	EC321
SEMESTER	**:**	8
CREDITS	**:**	4
HOURS PER WEEK	**:**	6 (Theory – Practice)
PREREQUISITES	**:**	EC122 Strength of Materials II
CONDITION	**:**	Compulsory
INSTRUCTOR	**:**	Carlos Zavala, Cesar Aranis
INSTRUCTOR E-MAIL	**:**	czavala@uni.edu.pe

II. COURSE DESCRIPTION

Conceptually define behavioral fundamentals of steel as structural element. Understand the way they are assembled, supported, held up and how they transmit loads in metallic structures. Learn philosophies and design processes. Study the specification of the Load and Resistor Factor Design developed by the American Institute of Steel Construction (AISC) and by the standard NTE E.090; which requires a special grasp of the structural behavior for the several failure limit states to be considered in the design process.

III. COURSE OUTCOMES

1. Define the necessity or demand to be met; object (element, structure).
2. Define criteria (of complexity, importance, safety, functionality).
3. Apply conceptual criteria, propose alternatives and exclude the unsuitable ones for the designer.
4. Communicate the selected ideas and express them in draws, schemes and notes.
5. Structure and dimension the most suitable – solid and forceful – idea, giving it dimensions and magnitudes.
6. Build the structural model using design codes, converting it into a physical model.
7. Design the object (element, structure) and take it to detail plans, calculation log and specifications.
8. Interpret and build Civil Engineering projects according to current standards.

IV. LEARNING UNITS

1. STEEL AS STRUCTURAL MATERIAL. TYPES OF STRUCTURES. LOADS AND LRDF / 24 HOURS

Basic concepts of the steel as structural element / Loads and LRDF, last combinations / Elements to tension. Profiles and plates / Introduction to bolted connection.

2. CONNECTIONS, TYPES: BOLTED AND WELDED / 7 HOURS

Types of connections: joint contact and joint friction / Bolted connections: Traction and shear, traction and shear simultaneous. Off-center connections. Guys / Soldered connections, types. Systems of symbols / Soldering design.

3. BENDING IN BEAMS WITH OR WITHOUT LATERAL SUPPORT. COMPOUND SECTIONS / 32 HOURS

Bending in beams. Beam bulge phenomenon / Design limit states / Design of beans laterally supported with compact sections / Elastic lateral-torsional bulge phenomenon in Section I beams / Design of beams laterally unsupported. Beam base plate. Compound sections.

4. **COLUMNS UNDER AXIAL LOAD, MEMBERS UNDER COMBINED FORCES, CONNECTION ELEMENTS / 32 HOURS**

Stable states of equilibrium, Flexural elastic bulge. Effective length. Inelastic stability. Local bulge / Design of axially loaded columns / Resistance of sections subject to combined loads, second-order moments. Amplification factors B1 and B2 / LRFD interaction formulas for designing beam-columns, Design and connections of simple shear, double angle, end plate in shear, stiffened and unstiffened settlement.

5. **WOOD STRUCTURES DESIGN / 10 HOURS**

Wood types according to norm NTE-010 / Types of wood structural systems / Moments, shear and stress in wood beams / Rectangular and circular sections / Wood beams design / Long and short beams / Effective length / Wood planking design.

V. PHASED-WORK PROJECT

TE-1: Design problem definition and scope.
TE-2: Loads, structural analysis, critical combinations, elements design.
TE-3: Sectional and plant planes, structure details, foundations, costs estimation.

VI. METHODOLOGY

The course is carried out in computing lab, theory and practice sessions. In theory sessions, the instructor introduces design concepts, fundamentals and applications. In practice sessions, several design cases and problems are solved, and their solutions are analyzed. In lab sessions, ETABS and SAP200 software programs are used to make complex designs. At the end of the course students must hand over and expose projects carried out in stages. In all sessions, students' active participation is encouraged.

VII. EVALUATION FORMULA

The average grade PF is calculated as follows:

$$PF = 0.25\,EP + 0.25\,EF + 0.2\,PP + 0.3\,TE$$

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

VIII. BIBLIOGRAPHY

1. **NATIONAL BUILDING REGULATION**
   LEGAL REGULATIONS OF THE OFFICIAL NEWSPAPER EL PERUANO
   Urban Peru Editorial, 2006

2. **SPECIFICATIONS FOR STRUCTURAL STEEL BUILDINGS**
   American Institute of Steel Construction – AISC, 2010

3. **VINNAKOTA, SRIRAMULU**
   Steel Structures: Behavior and LRFD (Spanish)
   Mc Graw – Hill. 1st edition (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.	**K**
Environmental Appraisal	Takes into account the importance of preserving and improving the environment in the development of their personal and professional activities.	**K**
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**