INTEGRATED COURSE: ELEMENTS OF STRUCTURAL MECHANICS AND STRUCTURAL ENGINEERING

Prof: Abis Massimo (Structural mechanics); Pani Luisa (Structural engineering)
Credits: 6 + 5
Term: 3rd, 1st

Prerequisites
CONSTRUCTION SCIENCE:
Mathematical analysis, Geometry
CONSTRUCTION TECHNIQUES:
Construction science

Objectives of the course
CONSTRUCTION SCIENCE:
Calculate the internal reactions and draw the related diagrams for isostatic structures.
Know and apply resolution methods for hyperstatic structures studied during the course.
Determine the stress in a section for the principal cases of De Saint Venant and know the criteria for resistance verification.
Know the basic problems related to the stability of equilibrium.

CONSTRUCTION TECHNIQUES: 1.
1. Extension and consolidation of the information and capacity for comprehension associated with the first cycle.
2. Ability to apply knowledge, understand and to solve problems that require recourse to other disciplines.
3. Ability to integrate knowledge, manage complexity, and formulate judgements based on limited or incomplete information; discussion of responsibility.

Course contents
CONSTRUCTION SCIENCE:
Isostatic structures: balance of constraints and determination of constraint actions, calculation of internal actions, determination of stress levels, resistance verification.
Hyperstatic structures: methods of forces and deformation.

The course is structured as follows:
5 hours a week, of which 3 hours of lectures and 2 hours of practical sessions, for a total of 12 weeks.
First part: 20 hours
- INTERNAL ACTIONS Reactions of internal constraints. Results and components of internal actions. Internal actions of isostatic structures.
- RETICULAR BEAMS Reticular beams loaded at the nodes.
- EQUILIBRIUM BETWEEN PLANE BEAMS Frame beams: indeterminate conditions of equilibrium. Resolution via analysis and graphics.
Second part: 20 hours
- **STRESS CONDITIONS AROUND A POINT** Definitions. Indefinite equations of equilibrium. Stress in accordance with a particular direction. Principal tensions.
- **STATE OF DEFORMATION AND ELASTIC EQUILIBRIUM** Deformation consequent upon the state of strain. Hooke's law. Elastic work. Relationship between displacement and deformation. Congruence equations. Indefinite equations of the elastic equilibrium (outline).
- **RESISTANCE VERIFICATION** Introduction to the resistance of materials. Breakage criteria and resistance verification.

Third part: 20 hours
- **THE STUDY OF HYPERSTATIC STRUCTURES** Force resolution method. Displacement resolution method.
- **HYPERSTATIC FRAME STRUCTURES** Frame beams: differential equation of the elastic line. Mohr's theorem.
- **STABILITY OF EQUILIBRIUM** Compressive and flexural strength of thin poles. Critical load.
- **STUDY OF ELASTIC STRUCTURES USING THE PRINCIPLE OF VIRTUAL WORK** The virtual work principle. How to apply the virtual work principle. Search for displacement and calculation of hyperstatic reactions using the virtual work principle.

**CONSTRUCTION TECHNIQUES:**

The course is structured as follows:
1. Structural safety (2 hours of lectures, 1 hour practical session)
2. Load analysis (3 hours of lectures, 2 hours of practical sessions)
3. Hyperstatic structures (8 hours of lectures, 4 hours of practical sessions)
4. Construction materials (2 hours of lectures)
5. Ultimate Limit State of reinforced concrete (8 hours of lectures, 4 hours of practical sessions)
6. Structural elements of reinforced concrete (7 hours of lectures, 3 hours of practical sessions)
7. Practical design rules (3 hours of practical sessions)
8. Executive drawings (3 hours of practical sessions)

**Teaching methods**
Lectures and practical sessions with the support of the tutor

**Assessment methods**
Oral exam with exercises

**Recommended reading**
CONSTRUCTION SCIENCE: Students will be provided with teaching material to be used for the preparation of the exam. To broaden some of the topics the following texts are recommended:
Michele Capurso LEZIONI DI SCIENZA DELLE COSTRUZIONI
CLUP Milano LEZIONI DI SCIENZA DELLE COSTRUZIONI
Odone Belluzzi SCIENZA DELLE COSTRUZIONI Volumi 1 - II
CONSTRUCTION TECHNIQUES: E. Pozzo Teoria e Tecnica delle Costruzioni I e II vol.