NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF CIVIL ENGINEERING

CIVIL ENGINEERING PROGRAM

SYLLABUS - WATER SUPPLY AND SEWAGE SYSTEMS

I. GENERAL INFORMATION

CODE	:	SA253
SEMESTER	:	8
CREDITS	:	4
HOURS PER WEEK	:	5 (Theory – Practice)
PREREQUISITES	:	HH113 General Hydrology
CONDITION	:	Compulsory
DEPARTMENT	:	Hydraulic s and Hydrology
INSTRUCTOR	:	Carlos Ibanez, Guillermo Cordova, Sabino Basualdo
INSTRUCTOR E-MAIL	:	cibanez@spedy.com.pe

II. COURSE DESCRIPTION

The course prepares students for the analysis and design of water supply networks in rural and urban population as well as the design of the corresponding sewage systems. Students apply the knowledge of hydraulics, fluid mechanics, flows in pipes, channels, orifices and other accessories for designing a complete network system of water supply and sewage using cadastral information, water sources availability, city topography, population size projections, among other required information. Students work in teams to complete the design project and submit and defend a technical report.

III. COURSE OUTCOMES

1. Apply statistical criteria for analyzing population grow and cadastral information.
2. Efficiently apply design hydraulic criteria.
3. Understand the operation of water supply systems.
4. Adequately interpret national and international design rules and regulations.
5. Propose water supply network typologies considering topographical and economical aspects.
6. Compute pressure and flows for determining the size and characteristics of water supply network components.
7. Elaborate technical drawings using specialized software.
8. Design sewage systems including wastewater treatment plant and considering environment protection aspects.
9. Elaborate project reports including technical drawings and cost estimates.

IV. LEARNING UNITS

1. DESIGN PARAMETERS AND VARIABLES

Interpretation of the main design parameters: population dynamics / Population dynamics, endowments and coefficients of consumption variation: Systems topology / Production, transmission, storage and distribution systems / Imprisoning system / Invoicing system / Water treatment: sedimentation, filtration, chlorination, fluorination / Water quality.

2. WATER SOURCES

Water supply sources / Rain water / Surface and underground water / Sea and icebergs / Rivers, lakes / Fountains and wellsprings.

3. UNDERGROUND WATER
Types of underground water tables / Infiltration and porosity / Filtration speed / Hydraulic conductivity / Permanent and non-permanent flows / One-directional permanent flow / Radial flows in wells / Confined and non-confined aquifers / Dupuit equation / Theis equation / Flows close to aquifer borders / Multiple well systems and interference / Well specific capacity and performance.

4. CONDUCTION LINES
Materials selection: conduction capacity, resistance, durability / Safety and leakages / Maintenance and disinfection / Internal pressure and stress / Anchorage / Stress by temperature changes / Water hammer / Joukowsky formula.

5. PIPES STRENGTH AND MATERIALS. PIPES ACCESORIES
ASTM norms / Load factors, security factors / Method for placing pipes / External loads in underground pipes / Flexible and rigid pipes / Anson Martson experience / Concentrated and distributed loads / Steel pipes / Iron pipes / Concrete Pipes / Plastic pipes / Internal protection of pipes / Water treatment / Pipes accessories / Air valves / Check valves / Pressure regulating valves / Drainage valves / Water hammer damping valves / Pipes connectors and unions.

6. PLANNING OF WATER SUPPLY SYSTEMS
Network typologies; fishbone, reticulated, closed circuit / Hydraulic design of a closed circuit network / Design flow / Service pressure / Minimum diameter / Hardy Cross method / Method of equivalent pipes / Tong O'Connor, Stearns and Lynch method / Raman method / Sectioning methods / Fruhling criteria / Lugger Mannes criteria / Network optimization criteria / Open network systems / Design norms.

7. SEWAGE SYSTEMS
Sanitary and pluvial sewage / Factor affecting download / House connections: laterals, principals, primary collectors / Flow design / Return coefficients / Drainage area / Minimum collector depth / Hydraulic design of collectors / Minimum diameter / Rational method / Design norms / Sinking / Sedimentation / Served water treatment / Stabilization lagoons / Primary and secondary treatment Anaerobic treatment.

V. METHODOLOGY

In the first half of the academic semester the instructor presents and analyzes the main aspects and considerations for designing water supply networks and sewage systems. In the second half of the semester, students are grouped in teams to carry out and complete the design of a water supply network for an urban or rural area with growing population and given economical, social and environmental constraints. Afterwards, students complete the design of the sewage system.

VI. EVALUATION FORMULA

The average grade PF is calculated as follows:

PF = 0.33 EP + 0.33 EF + 0.16 10 + 0.24TE

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

VIII. BIBLIOGRAPHY

1. **FAIR, GORDON; GEYER, JHON; OKUN, DANIEL**
   Water Supply and Sewage Systems
   Limusa Editorial, Mexico, 2000

2. **LOPEZ CUALLA, RICARDO ALFREDO**
   Design of Water Pipe Networks and Sewage Systems

3. **HAZEN AND WILLIAMS G. S.**
Hydraulic Tables, N.Y.

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	**R**
Modern Engineering	Use and apply techniques, methods and tools of modern engineering necessary for the practice of civil engineering.	**K**
Engineering Impact	Understand the impact of engineering solutions on people and society in local and global contexts.	**K**
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.	**K**
Contemporary Issues	Know and analyze relevant contemporary issues in local, national and global contexts.	**K**
Ethics and Professional Responsibility	Evaluate their decisions and actions from a moral perspective and assume responsibility for the executed projects.	**K**
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**