NATIONAL UNIVERSITY OF ENGINEERING

COLLEGE OF CIVIL ENGINEERING

CIVIL ENGINEERING PROGRAM

HH333 – HYDRAULIC RESOURCES

I. GENERAL INFORMATION

CODE	**:**	HH333 – Hydraulic Resources
SEMESTER	**:**	8
CREDITS	**:**	04
HOURS PER WEEK	**:**	06 (Theory – Practice)
PREREQUISITES	**:**	HH113 – General Hydrology
CONDITION	**:**	Mandatory

II. COURSE DESCRIPTION

The course prepares the student in the application of the concepts, methods and techniques for the formulation and evaluation of projects for the use of surface and underground water resources, and for the control and management of extreme events. It prepares it in information management, water supply and demand estimation skills, using modeling, optimization and evaluation techniques considering objectives: technical, economic, social, environmental and legal, current and with future projection. Projects are analyzed for different purposes of the use of water resources and the control and mitigation of extreme phenomena of water origin. Principles of environmental law and policy, concepts of sustainability and conservation in the management of water resources are introduced.

III. COURSE OUTCOMES

At the end of the course the student will:

- Identify, formulate and propose solutions to the current problem of the use of hydraulic resources.
- Plan, design and operate hydraulic systems.
- Understand, take into account and uses techniques of economic, social and environmental evaluation of a hydraulic project.
- Apply methodologies for optimization of the hydraulic resource, through interdisciplinary models and techniques.

IV. LEARNING UNITS

1. **NATURE OF HYDRAULIC RESOURCES, PLANNING AND ENGINEERING AND INFORMATION MANAGEMENT (6 Hours)**
   Introduction / Projects: Analysis methodology, development stages, basic information management / Situation status of water resources in the country. National plan and laws in force.

2. **OFFER STUDY, DEMAND AND WATER BALANCE OF THE PROJECT (20 hours)**
   Water resources availability analysis / Irrigation demand study / Municipal water demand / Hydropower availability / Demand for river navigability. Study of avenues: application for drainage works, defenses and debris flow / Study of droughts / Underground hydrology / Water quality / Water footprint.

3. **FORMULATION OF HYDRAULIC PROJECTS (16 hours)**
   Problem identification (supply / demand balance, alternatives) / Project description / Identification of Activities and subtasks / Schedule of activities schedule / Cost estimation.

4. **EVALUATION OF A TECHNICAL, ECONOMIC, SOCIAL, ENVIRONMENTAL AND MULTIPLE PURPOSE PROJECT (12 hours)**
   Economic evaluation: Annual costs and benefits, economic indicators, sensitivity analysis / Criteria for environmental and social evaluation / Selection of alternatives.

5. **OPTIMIZATION AND SIMULATION OF WATER TREATMENT SYSTEMS (22 hours)**
   Systems engineering application / Optimization criteria / Optimization methodologies: linear programming, application software / Reservoir operation simulation, application software.

V. LABORATORIES AND PRACTICAL EXPERIENCES

- Structured Work related to Hydraulic Resources.

VI. METHODOLOGY

The course takes place in theory and practice sessions. In the theory sessions the concepts, theories and methodologies corresponding to each learning unit are presented, presented examples and applications to real situations. In all sessions the active participation of the student is promoted. In the structured work a small-scale project is developed at the profile level, at the end of the course the student must present and present an integrating work or project. In the qualified practices, the development of the skills indicated for the course is evaluated. Some results are verified by applying a free-use software.

VII. EVALUATION FORMULA

The learning will be evaluated through the "G" system.

- Partial Exam (PE): Weight 1
- Final Exam (FE): Weight 1
- Average of Practices (P) / Monographic Work (P5): Weight 1.

$$FA = \frac{PE + FE + P}{3}$$

VIII. BIBLIOGRAPHY

- Helweg, Otto. (1992). Hydraulic Resources, Planning and Administration. Mexico: Limusa-Noriega Editorial.

- Holden, J. (2014). Water Resources: An Integrated Approach. England: Routledge Editorial

- Linsley, Ray; Franzini, Joseph. (1988). Hydraulic Resources Engineering. Mexico: Editorial Cecsa.

- Loucks, D.P., & Van Beek, E. (2017). Water Resource Systems Planning and Management. USA: Springer Publishing.

- Mays, L.W. (2010). Water Resources Engineering USA: Editorial John Wiley & Sons.

- Rocha, Arturo. (1993). Hydraulic resources. Peru: Editorial Civil Engineer Collection