



**NATIONAL UNIVERSITY OF ENGINEERING**  
**COLLEGE OF GEOLOGICAL, MINING AND METALLURGICAL**  
**ENGINEERING**

**MINING ENGINEERING PROGRAM**

---

**SM954 – MINING AND ENVIRONMENT**

**I. GENERAL INFORMATION**

<b>CODE</b>	: SM954 Mining and Environment
<b>SEMESTER</b>	: 9
<b>CREDITS</b>	: 3
<b>HOURS PER WEEK</b>	: 4 (Theory–Practice)
<b>PREREQUISITES</b>	: SM823 Mining Safety and Hygiene
<b>CONDITION</b>	: Compulsory

**II. COURSE DESCRIPTION**

The course prepares students to understand the global and local aspects of environmental pollution in mining, the active and passive sources of environmental pollution, the monitoring and mitigation of water, gas, soils, tailings and waste pollution, and the formulation of environmental policies. Students prepare studies and reports of environmental impact, and evaluate programs for environmental adaptation and management. National and international rules of environmental control are analyzed, and applied to environmental audits, and mining sustainable development.

**III. COURSE OUTCOMES**

At the end of the course, students:

1. Organize data for environmental assessment and evaluation.
2. Explain the environmental impacts of different mining projects.
3. Understand the generation of environmental impacts by active and passive mining sources, as well as the types of environmental pollution.
4. Interpret the results of environmental monitoring of water, air and soil.
5. Build plans to develop programs of environmental pollution mitigation.
6. Carry out and complete study-reports of environmental impact, formulation of programs of environmental adaptation, as well as mines closure plans.
7. Analyze the General Environmental Code and the results of environmental audits.

**IV. LEARNING UNITS**

**1. INTRODUCTION ENVIRONMENTAL LEGAL FRAMEWORK**

The pollution global evolution on Earth, evolutionary framework of pollution from the mining activity/ Multidisciplinary study of the environment / Legal considerations to prevent pollution by mining activities / Regional and local application of environmental policy in mining areas.

**2. SOURCES OF IMPACT AND ENVIRONMENTAL MONITORING**

Active and passive sources of environmental pollution / Monitoring stations of liquids, solids, gases and particles.

**3. POLLUTION AND REMEDIATION OF WATER**

Water pollution: monitoring, analysis, maximum permissible limits, toxicology, impacts and remediation programs / Treatment of cyanide. / Remediation process of wastewater with cyanide.

#### **4. POLLUTION AND REMEDIATION OF SOIL AND AIR**

Contamination of soils by tailings: monitoring, analysis, maximum permissible limits, impacts and rehabilitation programs / Air pollution: introduction, monitoring, analysis, maximum permissible limits, toxicology, impacts and mitigation.

#### **5. STUDIES OF ENVIRONMENTAL IMPACT, ENVIRONMENTAL ADAPTATION AND MANAGEMENT PROGRAMS**

Environmental impact studies / Environmental adaptation and management programs. / Mine-closure plans / Analysis of mining pollution problems in Peru and the world.

### **V. LABORATORY AND PRACTICE SESSIONS**

1. **Session 1:** Evolution and control of the environmental pollution / Application of the environmental legal framework in mining.
2. **Session 2:** Identification of pollutant sources. / Methodology of the environmental monitoring of water / Processes of remediation of acid water.
3. **Session 3:** Remediation process of wastewater with cyanide.
4. **Session 4:** Static and kinetic tests of acid drainage of tailing and waste-dismount.
5. **Session 5:** Air monitoring.
6. **Session 6:** Environmental impact, cases of study.
7. **Session 7:** Cases of environmental adaptation and management programs.
8. **Session 8:** Application cases of the ISO 14001 rule and environmental audits.

### **VI. METHODOLOGY**

The course is organized in sessions of theory in classroom and experimental practice in the Institute of Mining and Environment where students carry out laboratory experiences on water, air and soil monitoring, acid and cyanide water mitigation and removal of metals in liquid effluents. Students must participate actively.

### **VII. GRADING FORMULA**

The Final Grade PF is calculated as follow:

$$PF = (EP + EF + PP) / 3$$

EP: Mid-term Exam      EF: Final Exam  
PP: Average of Practical Works.

### **VIII. BIBLIOGRAPHY**

1. Edward A. Keller  
Introduction to Environmental Geology. Prentice Hall. Third edition, 2015.
2. C.G. Down and J. Stocks.  
Environmental Impact of Mining, Applied Science Publishers LTD, 2007