# COURSE OUTLINE

## 1. COURSE INFORMATION

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| **SCHOOL** | Technical University of Crete | | |
| **DEPARTMENT** | Mineral Resources Engineering | | |
| **COURSE LEVEL** | Graduate | | |
| **COURSE ID** | | **SEMESTER** | Winter / Spring |
| **COURSE TITLE** | Fundamentals of Mineral Processing | | |

| **COURSE MODULES** *in the case of credits being awarded in distinct parts of the course eg. Lectures, Laboratory Exercises, etc. If credit units are awarded uniformly for the whole course, indicate the weekly hours of teaching and the total number of credits.* | **INSTRUCTION HOURS PER WEEK** | **CREDITS** |
|---|---|---|
| Lectures | 2 | |
| PBL | 1 | |
| Laboratories | | |
| Tutorial Exercises | | |
| **Total** | 3 | 6 |
| *Add rows if needed. The teaching organization and teaching methods used are described in detail in (4).* | | |

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| **COURSE TYPE** *Background, General Knowledge, Scientific Area, Skills Development* | Core elective |
| **PREREQUISITES:** | Mineral chemistry - mineralogy, Solid background in applied fluid mechanics |
| **INSTRUCTION/EXAM LANGUAGE:** | English |
| **THE COURSE IS OFFERED TO ERASMUS STUDENTS:** | Yes |
| **COURSE URL:** | EURECA-PRO LMS Moodle URL: https://moodle.eurecapro.tuc.gr/course/view.php?id=73 |

## 2. LEARNING OUTCOMES

**Learning Outcomes**

*The learning outcomes of the course describe the specific knowledge, skills and competences of an appropriate level that students will acquire after successfully completing the course.*

*Refer to Appendix A.*

- *Description of the Level of Learning Outcomes for each course of study in line with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators of Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Annex B*
- *Learning Outcomes Writing Guide*

After completing this course the student will be able to:

- ✓ Design and analyze open/close comminution circuits
- ✓ Define and understand the fundamental principles of mineral processing
- ✓ Calculate the mass balances for mineral processing circuits
- ✓ Analyze and apply the main mineral processing methods, e.g. magnetic and gravity separation, flotation etc., in practical separation tests for various ores
- ✓ Evaluate the performance and efficiency of mineral processing operations
- ✓ Understand the basic principles of fluid particle interactions in the dilute and dense bed limits
- ✓ Design and analyze the operation of fluidized beds for mineral processing

Co-funded by the Erasmus+ Programme of the European Union

**General Competencies/Skills**

*Considering the general competencies that the graduate must have acquired (as listed in the Diploma Supplement and below), which one(s) the course enhances?*

*Search, analysis and synthesis of data and information, using the necessary technologies*
*Adaptation to new situations*
*Decision making*
*Autonomous work*
*Teamwork*
*Working in an international environment*
*Working in an interdisciplinary environment*
*Production of new research ideas*
*Project design and management*
*Respect for diversity and multiculturalism*
*Respect for the natural environment*
*Demonstration of social, professional and moral responsibility and sensitivity to gender issues*
*Exercise criticism and self-criticism*
*Promoting free, creative and inductive thinking*

Search, analysis and synthesis of data and information
Promoting free, creative and inductive thinking
Technology assessment (economic, environmental, social)
Decision making
Teamwork
Working in an interdisciplinary environment
Production of new research ideas

## 3. COURSE SYLLABUS

**Lecture 1:** Introduction to mineral processing, particle size & particle size distribution, sieve analysis, screen types, industrial screening, mass balances, exercises
**Lecture 2-3:** Particle size distribution models, size reduction, comminution machines, exercises
**Lecture 4:** Open / close circuit operations, mass balances, exercises
**Lecture 5-6:** Liberation / degree of liberation, mineral processing circuits, mass balances, metal units, recovery, exercises
**Lecture 7-8:** Optical & magnetic separation, gravity separation, heavy media separation, types of concentrators, exercises
**Lecture 9:** Froth flotation, collectors, activation and depression mechanisms, flotation cells, flotation circuits, basic principles of settling and classification, exercises.
**Lecture 10:** Fundamentals of flow past solids- Fluid-solid interactions
**Lecture 11:** Introduction to the dynamics of fluidized beds
**Lecture 12:** Reaction Kinetics in fluidized beds
**Lecture 13:** Numerical simulation of fluidized beds using COMSOL Multiphysics – Hands on practice

## 4. TEACHING and LEARNING METHODS – ASSESSMENT

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| **LECTURE METHOD**<br>*Face to face, distance learning, etc.* | Face to face, distant learning and PBL: the presence of students in all lectures is **obligatory** |
| **USE OF INFORMATION AND COMMUNICATION TECHNOLOGY**<br>*Use of ICT in Teaching, in Laboratory Exercises, in Communication with students* | Microsoft Excel and Microsoft Powerpoint will be used during classes and project implementation. |

**TEACHING ORGANISATION**

*Describe in detail the way and methods of teaching.*
*Lectures, Seminars, Laboratory Exercise, Field Exercise, Literature review & analysis, Tutoring, Practice (Placement), Clinical Exercise, Artistic Lab, Interactive teaching, Educational visits, Project work, project, etc.*

| *ACTIVITY* | *Workload per semester (in Hours)* |
|---|---|
| Lectures | 26 |
| Tutorials | |
| Lab assignments | |
| Projects | 26 |
| Autonomous study | 98 |
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| *The student's study hours for each learning activity and the hours of non-guided study according to the ECTS principles are mentioned.* | ***Course Total (25 hours' workload/ECTS credit)*** | ***150*** |
| **ASSESSMENT METHODS**<br>*Description of the evaluation process*<br><br>*Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Public Presentation, Laboratory Assignment, Clinical Examination of Patients, Artistic Interpretation, Other*<br><br>*Well defined student assessment criteria are mentioned. Mention whether and how the students can access them.* | 2 Projects per student (involving teamwork) through PBL. 20' presentation with a ppt file, Q&A: 60%<br><br>A research article in a relevant topic will be prepared by each student. A ~3 page summary and ppt presentation will be prepared, involving critical analysis of the topic: 40% | |

## 5. DIGITIZATION (use of tools & software)

Students are required to perform calculations in Microsoft Excel spreadsheets (mass balance, economic and energy indicators etc) using the relevant tools and also prepare ppt presentations. The use of COMSOL Multiphysics will be demonstrated for the modeling of flow and reaction kinetics in fluidized beds.

## 6. RECOMMENDED INTERNATIONAL LITERATURE

- Wills, B.A.; Finch, J.A. 2016. Wills Mineral Processing Technology: An Introduction to the Practical Aspects of Ore Treatment and Mineral Recovery, Butterworth-Heinemann Publishers, Oxford, UK.
- Fuerstenau, M.C.; Han, K.N. 2003. Principles of Mineral Processing, Society for Mining, Metallurgy, and Exploration, USA.
- Allen, T. 2003. Powder Sampling and Particle Size Determination; Elsevier: Amsterdam, The Netherlands.
- Petrakis, E.; Stamboliadis, E.; Komnitsas, K. 2017. Identification of optimal mill operating parameters during grinding of quartz with the use of population balance modeling. KONA Powder and Particle Journal 34, 213-223.
- Petrakis, E.; Komnitsas, K. 2019. Effect of energy input in a ball mill on dimensional properties of grinding products. Mining, Metallurgy & Exploration, 36 (4), 803-816.
- Petrakis E., Karmali V., Komnitsas K. 2021. Factors affecting nickel upgrade during selective grinding of low-grade limonitic laterites. Mineral Processing and Extractive Metallurgy, 130 (3), 192-201
- Petrakis, E.; Komnitsas, K. 2021. Development of a non-linear framework for the prediction of the particle size distribution of the grinding products. Mining, Metallurgy & Exploration, 38 (2), 1253-1266.
- Transport Phenomena, Revised 2nd Edition, R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot, WILEY
- Fluidized-Bed Reactors: Processes and Operating Conditions, John G. Yates and Paola Lettier, SPRINGER

Acknowledgement: *"Co-funded by the ERASMUS+ Programme of the European Union" (Contractnumber: 101004049 — EURECA-PRO — EAC-A02-2019 / EAC-A02-2019-1)*