NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF PETROLEUM AND PETROCHEMICAL ENGINEERING
PETROCHEMICAL ENGINEERING PROGRAM

PI136 – LABORATORY OF UNIT OPERATIONS II

I. GENERAL INFORMATION

CODE	**:**	PI136 Laboratory of Unit Operations II
SEMESTER	**:**	9
CREDITS	**:**	2
HOURS PER WEEK	**:**	4 (Theory–Practice-Laboratory)
PREREQUISITES	**:**	PI135 Laboratory of Unit Operations I, PQ423 Mass Transfer
CONDITION	**:**	Compulsory

II. COURSE DESCRIPTION

The course prepares student for the practical application and analysis of unit operation commonly used in chemical industry. Students work in teams to carry experiments on spray-drying, liquid-liquid extraction, solid-liquid extraction, gas desorption, distillation and cooling tower. The objective of each experience is students apply the theoretical base of mass transfer for calculating mass flows and verify with experimental results. Students understand the principles of functioning of equipment and instruments and use them properly including setting up, calibration and shutting down in an environment similar to actual industrial plants. A steam generator proving of 30BHP providing 80 PSIG saturated steam is used for the operation of certain equipment.

III. COURSE OUTCOMES

At the end of the course, students:

1. Understand the principles and theoretical basis of each laboratory experience and related equipment.
2. Demonstrate ability in the operation, starting-up, calibration and shutdown of process equipment and instruments.
3. Apply knowledge of drying by atomization processes to the analysis, operation and maintenance of drying equipment and processes.
4. Apply knowledge of liquid-liquid extraction processes to the analysis, operation and maintenance of separators using proper solvents.
5. Analyze gas desorption processes for gas-liquid separation considering environmental impact.
6. Apply knowledge of distillation processes to the analysis, operation and maintenance of distiller plants.
7. Analyze and interpret experimental data and document their results, redacting and presenting well-grounded reports.

IV. LEARNING UNITS

1. LABORATORY OF GAS DESORPTION

Separation of a gas present in a liquid by desorption with another gas / Evaluation of the effect of pressure losses in a packed column, as well as analysis of the degree of desorption of the solution.

2. LABORATORY OF LIQUID-LIQUID EXTRACTION

Separation of liquid mixture and put in contact with a second liquid phase / Determination of the values and height of the transfer unit on the basis of the transfer of the refining phase.

3. ATOMIZATION DRYING LABORATORY

Drying solids present in a solution or suspension based on the high speed of the scattered fluid and the entry of hot air to take out moisture / Evaluation at different operation conditions such as variable temperature and flow / Determination of the quantity of dried products under continuous use of equipment.

4. LABORATORY OF COOLING TOWER

Analysis of cooling process in cooling towers and condensers / Corrugated sheets fillers for water cooling in reduced spaces / Determination of the number of units of diffusion and pressure losses.

5. LABORATORY OF SOLID EXTRACTION

Lixiviation / Extraction of a solute with a suitable solvent in a solid (natural or mineral product) / Analysis of mass transfer from the solid phase / Solute diffusion in the liquid-phase through the solid phase.

6. DISTILLATION LABORATORY

Separation of two compounds of different volatility contained in a liquid phase by heating / More volatile component gest out through the column top / Determination of transfer units and equivalent height.

V. LABORATORY SCHEDULE

Students are grouped in teams of four members (five at most) to complete each laboratory experience in a weekly schedule. Each laboratory experience takes two sessions of three-hours each (one session per week). In the following table the laboratory schedule for each student group is presented.

GROUPS	SESION 1	SESION 2	SESION 3	SESION 4	SESION 5	SESION 6
A, D	weeks 2, 3	weeks 4, 5	weeks 6, 7	weeks 9,10	weeks 11, 12	Weeks 13, 14
B, E	weeks 6, 7	weeks 2, 3	weeks 4, 5	weeks 13, 14	weeks 9, 10	weeks 11, 12
E, F	weeks 4, 5	weeks 6, 7	weeks 2, 3	weeks 11, 12	weeks 13, 14	weeks 9, 10

VI. METHODOLOGY

Each laboratory experience starts with a brief presentation of the theoretical background of the unit operation to be analyzed. Afterwards, students carry out the experience using a laboratory guide provided in advance. Students identify required equipment and instruments and formulate the objectives to be achieved. Proper data is taken, analyzed and drawn to verify the pertinence of the results. After completing each laboratory experience, students submit and defend a report according to a given format. Reports are evaluated according to rubrics based on the attainment level of expected outcomes. Student active participation is promoted, as well as continuous bibliography search and analysis regarding experimental unit operations.

VII. GRADING FORMULA

The Final Grade PF is calculated as follow:

PF = (EP + EF + PL) / 3

EP: Mid-term Exam EF: Final Exam
PL: Average of Laboratory Sessions Grade

VIII. BIBLIOGRAPHY

1. MC CABE WARREN L, SMITH JULIAN C., HARRIOT PETER. Basic Operations of Chemical Engineering, Mc Graw Hill, 2005.
2. FOUST A-S, WENZEL L.A. CLUMP C.W., MAUS LOUIS, ANDERSEN L.B. Fundamentals of Unit Operations, Ed. CECSA, 2008.