NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF CHEMICAL AND TEXTILE ENGINEERING
CHEMICAL ENGINEERING PROGRAM

PI510 – CHEMICAL PROCESSES ECONOMICS

I. GENERAL INFORMATION

CODE	**:**	PI510 – Chemical Processes Economics
SEMESTER	**:**	9
CREDITS	**:**	3
HOURS PER WEEK	**:**	4 (Theory–Practice)
PREREQUISITES	**:**	EP818 Costs and Budgets, PI144 Mass Transfer.
CONDITION	**:**	Compulsory
DEPARTMENT	**:**	Chemical Engineering

II. COURSE DESCRIPTION

The course prepares student in the analysis of the technical and economic feasibility of investment projects in the chemical industry. Given an investment opportunity, students determine the market size, required equipment, estimate costs and budgets, proposes financial appeceament schemes, and determine ad compare the economic feasibility of the project according to several criteria. Equipment depreciation and replacement, and risk and uncertainty issues are also included in the analysis of project feasibility. At the end of the course, students present and defend an investment project report.

III. COURSE OUTCOMES

At the end of the course, students:

1. Understand and solve problems of financial mathematics.
2. Apply projection methods for analyzing market size in terms of supply and demand.
3. Understand the concept of depreciation and its impact on the financial analysis of a project.
4. Estimate fixed and variable costs of an investment project.
5. Determine and compare the financial feasibility of investment projects according to different criteria.
6. Analysis the risks and uncertainties in an investment project and their impact on its technical and economic feasibility.

IV. LEARNING UNITS

1. GENERAL CONCEPTS

Inflation / Devaluation / Costs / Expenditures / Manufacturing cost / Prices, actual and current terms / Balance. / Scale economy. / Economic life. / Investment projects. / Stages in a project development.

2. FINANCE MATHEMATICS

Simple and compound interest / Annuities / Nominal and effective interest / Inflation / Real interest.

3. FUTURE FINANCIAL STATEMENTS

Profits and losses statement / Cash flow / Balance sheet.

4. MARKET ANALYSIS

Classification of market / Elements of the market / Functions of supply and demand / Elasticity / Perfect market / Distortions of perfect market / Projection considerations / Statistical methods for demand projecting.

5. **EQUIPMENT AND PROCESSING UNITS INVESTMENT**
   Fixed capital (fixed and intangible assets) / Sources of information / Method of cost indexes / Method of power factor / Method of cost factor / Working capital / Financing.

6. **FIXED ASSETS DEPRECIATION AND INTANGIBLE ASSETS AMORTIZATION**
   Tangible and intangible assets / Depreciable investment / Recovery value / Depreciation methods / Effects of depreciation.

7. **PRODUCTION COSTS**
   Estimation requirements / Structure / Components of manufacturing costs (fixed, variable and regulated) / Estimation of manufacturing costs.

8. **INVESTMENT EVALUATION CRITERIA**
   Capital cost / Net Present Value / Internal Rate of Return / Benefit relationship cost / Index of Net Present Value / Internal Marginal Rate of Return / Incremental Net Present Value / Cumulative Net Present Value / Period and recovery / Discrepancies between Net Present Value and Internal Rate Return.

9. **REPLACEMENT ALTERNATIVES**
   Buy or rent / Buy or repair / Repair or rent / Total-partial replacement / Economic life / Optimum time to replace an equipment.

10. **RISK AND UNCERTAINTY ANALYSIS**
    Measurement of risk / Certainty equivalence / Adjusted discount rate / Sensitivity analysis / Decision trees / Montecarlo simulation.

11. **MATHEMATICAL MODELING**
    Stages of modeling / Degrees of freedom and processes specification / Algorithm for solution of equations of optimal time to replace an equipment.

12. **OPTIMIZATION**
    Analytical method of Lagrange multipliers / Optimization of continuous operations (compression in several stages, pipe diameter, thickness of insulation, tank agitation, reactors and tubular, distance and power of compression for pumping stations, heat exchangers, etc.) / Construction of nomograms in continuous operations / Methods of incremental optimization (searching in a single direction, gradient method, method of Rosembrock and method of Powell).

V. METHODOLOGY

The course takes place in theory and practice sessions. In theory sessions, faculty presents the concepts, methods, and financial evaluation criteria. In practice sessions, students solve diverse problems related to project budget, project investment, financial feasibility criteria, equipment replacement, optimization, are solve and analyzed. At the end of the course, students submit and defend a final report. Student active participation is promoted, as well as continuous bibliography search and analysis.

VI. 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

VII. BIBLIOGRAPHY

1. HARRY SILLA
   Chemical Process Engineering: Design and Economics - CRC Press Book, 2003.