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

PI426 – PROCESS SIMULATION AND CONTROL

I. GENERAL INFORMATION

CODE	:	PI426 Process Simulation and Control
SEMESTER	:	10
CREDITS	:	4
HOURS PER WEEK	:	5 (Theory–Practice)
PREREQUISITES	:	PI-225 Chemical Kinetics and Reactor Design I
		PI-415 Control Instruments
CONDITION	:	Compulsory
DEPARTMENT	:	Chemical Engineering
INSTRUCTOR	:	Celso Montalvo Hurtado
INSTRUCTOR E-MAIL	:	cmh2nd@gmail.com

II. COURSE DESCRIPTION

Mathematics for systems analysis. Dynamic linear processes. Analysis of the dynamic behavior of classical control systems. Strategies. State variables. Digital control systems. Analysis of more complex control systems.

III. COURSE OUTCOMES

Students know the mathematical principles of automatic control engineering, as regards of the analysis of the dynamic behavior, design, tuning and simulation of control systems.

IV. LEARNING UNITS

1. MATHEMATICS FOR SYSTEMS ANALYSIS AND CONTROL

Laplace transforms / Solving Differential Equations.

2. COMPUTER SIMULATION

System design simulation / Process simulator / Inverse transform / Linearization / Complex variable theory / Block algebra.

3. LINEAR DYNAMIC PROCESSES

General balance equation / Transfer Functions / Application models.

4. SYSTEMS

First order systems / First-order in serial and second-order / Higher order systems.

5. COMPONENTS OF A CONTROL SYSTEM

Sensors / Transmitters / End elements / Drivers / Analog and digital controllers / Block diagrams / Examples.

6. LINEAR CONTROL SYSTEMS

Feedback principle / classic control algorithms / Modern control systems / Space theory for study.

7. PROCESSES

Analysis of transient response / Processes and controlled processes / Simulation Systems.

8. **DYNAMIC BEHAVIOR**

   Analysis of the dynamic behavior / Stability control system / Stability criteria / BIBO criteria / Routh criteria.

9. **FREQUENCY DOMAIN**

   Frequency response / Stability analysis of systems in the frequency domain.

10. **DIVERSE CONTROL SYSTEMS**

    Design and tuning controllers / Control systems more elaborate / Commercial simulator / Inferential control systems (fuzzy control) / Neural systems.

11. **COMPLEX CONTROL SYSTEMS**

    Control systems more elaborate / Dynamic complex processes (heat exchangers) / State of the art of control processes.

12. **DISTILLATION**

    Dynamics and Control of distillation columns / Simulation.

13. **REACTORS**

    Dynamics and control of reactors / Simulation.

14. **MISCELLANEOUS SYSTEMS**

    Dynamics and control of miscellaneous systems / Simulation.

V. LABORATORY AND PRACTICAL EXPERIENCES

First practice: Laplace transform.

Second practice: Control system (formulation of models).

Third practice: Frequency response.

Fourth practice: Control distillation columns.

First laboratory: Transient response of control systems of a heat exchanger.

Second laboratory: Setting controllers.

Third Laboratory: Heat exchange equipment.

VI. METHODOLOGY

The course is developed in theory and practical sessions. In the theory sessions, the instructor presents the concepts, theorems and applications. In the practical sessions, various problems are solved and their solutions are analyzed. In all sessions the active participation of the student is encouraged.

VII. EVALUATION FORMULA

The Average Grade PF is calculated as follow:

PF = (EP + 2*EF + PP) / 4

EP: Mid-Term Exam
EF: Final Exam
PP: Average of practices

VIII. BIBLIOGRAPHY

1. **STEPHONPOULOS, G.**
   Chemical Process Control and Introduction to Theory and Practice. Prentice - Hall Inc. 1984.
2. **COUGNANOUR AND KOPPEL**
   Process System Analysis and Control. Mc Graw Hill. 1965.
3. **WILLIAMS, T. J. AND LAUHER, V. A.**
   Automatic Control of Chemical and Petroleum Processes. Houston, 1963.