NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF ELECTRICAL AND ELECTRONICS ENGINEERING

TELECOMMUNICATIONS ENGINEERING PROGRAM

IT414 – DISCRETE TIME CONTROL

I. GENERAL INFORMATION

CODE	**:**	IT414 – Discrete Time Control
SEMESTER	**:**	7
CREDITS	**:**	03
HOURS PER WEEK	**:**	04 (Theory – Practice)
PREREQUISITES	**:**	IT433 – Automatic Control
CONDITION	**:**	Mandatory

II. COURSE DESCRIPTION

The course presents the student with control theory, design methods used in system analysis, control algorithms, and digital control systems, using the computer to solve and simulate different scenarios.

III. COURSE OUTCOMES

At the end of the course the student will:

- Recognize the importance of digital control as one approach to solve specific problems in the control area.
- Know how to analyze, design and control a discrete control system.
- Use computer simulation programs to solve problems related to control area.

IV. LEARNING UNITS

1. **INTRODUCTION TO DIGITAL CONTROL**
   Introduction to the theory of digital control. Historical development.

2. **CONTINUOUS SIGNAL SAMPLING**
   Sampling, sampling theorem, reconstruction, aliasing, determination of the sampling period.

3. **DISCRETE SYSTEMS MODELS**
   Sampling of continuous systems, state space, representation of models in state space, input-output models, Z transform, poles and zeros.

4. **DISCRETE SYSTEMS ANALYSIS**
   Stability, Controllability and Observability, analysis of a simple feedback system.

5. **DESIGN METHODS**
   Top-down and bottom-up methods, simple loop design and determination of the main elements in the design of a control system.

6. **ANALOG DESIGN TRANSFER**
   Approaches, digital PID controller, redesign of status feedback, design with frequency response methods.

7. **DESIGN WITH STATE SPACE METHODS**
   Regulation using pole positioning by status feedback, observers, output feedback.

8. **PLACEMENT OF USED POLES INPUT-OUTPUT MODELS**
   Formulation of the problem, solution, algebraic problems, design procedure, sensitivity and modeling errors, relationship with other design methods, practical aspects and examples.

V. METHODOLOGY

The course is developed in theory and practice sessions, in the theory sessions the professor introduces the concepts of digital control theory, and in the practical sessions various problems are solved by analyzing their solution and indicating the real application of digital control systems. In all the sessions the active participation of the student is promoted.

VI. EVALUATION FORMULA

The learning will be evaluated through the "F" system:

- Midterm Exam (ME): weight as 1
- Final Exam (FE): weight as 2
- Average of Quizzes (Q): weights as 1

The final grade (FG) is obtained as follows:

$$\boldsymbol{FG} = \frac{\boldsymbol{ME} + \boldsymbol{2} * \boldsymbol{FE} + \boldsymbol{Q}}{\boldsymbol{4}}$$

VII. BIBLIOGRAPHY

- "Advanced Discrete-Time Control", Khalid Abidi. Springer, 2015.

- "Discrete Control Systems", Yoshifumi Okuyama. Springer Science & Business Media, 2013

- "Computer Controlled Systems Theory and Design, 2nd Edition" Astrom, KJ. Y. Wittermaric B. Prentice-Hall, 1990.