



NATIONAL UNIVERSITY OF ENGINEERING

COLLEGE OF ECONOMICS AND STATISTICAL ENGINEERING

STATISTICAL ENGINEERING PROGRAM

EC614 – INTRODUCTION TO SYSTEMS THEORY

I. GENERAL INFORMATION

CODE	: EC614 Introduction to Systems Theory
SEMESTER	: 6
CREDITS	: 2
HOURS PER WEEK	: 3 (Theory – Practice)
PREREQUISITES	: EC417 Computer Programming II
CONDITION	: Compulsory

II. COURSE DESCRIPTION

The course develops within the student the knowledge of systems science applied to the analysis and solving of complex problems of human reality. The course presents the fundamental concepts of systems, their properties as well as the principles of a unified and general theory applied to the holistic and integrated understanding of reality, allowing the comprehension of complex systems and the understanding of physical, biological, organizational and social phenomena, looking for developing models that better represents their behavior and using them to formulate optimization and improvement proposals.

III. COURSE OUTCOMES

1. Understand the systemic phenomena and explain systems concepts and properties.
2. Identify systems in quotidian reality phenomena and apply systemic concepts in their modeling.
3. Shows interest and motivation for applying the Systems General Theory.
4. Differentiate the classic science from the systems sciences and understand systemic phenomenology.
5. Understand the methodologies for systems improvement.

IV. LEARNING UNITS

1. GENERAL CONCEPTS / 8 HOURS

Sciences and engineering / Systems engineering: origin, objectives, evolution, pertinence / Systems / Open and closed systems / Growing / Competence / Systems hierarchy / Totality / Mechanization / Centralization / Isomorphism.

2. BASIC PRINCIPLES / 8 HOURS

Need of principles / Subsidiarity and interaction / Determinism / Equivalence / Pervasiveness / Multi-causality / Uncertainty / Complementarity / Complexity / Subordination / Homeostasis / Alometry.

3. SYSTEMS CHARACTERISTICS / 8 HOURS

Stability / Adaptability / Efficiency / Synergy / Communication / Control / Emergency / Hierarchy / Classification / Descriptive models / Behavior models / Methodology of systemic modeling.

4. SYSTEMS THEORY AND CYBERNETICS / 8 HOURS

Methodology for systems improvement / Methodologies for systems design / Methodologies comparison / Systems response / Systems systemic classification / Constructivism / Origin of cybernetics / Required variety / Subsidiarity / Regulation.

5. SYSTEMS MORALITY / 8 HOURS

Values assessment / Outcomes of change / Human factor in systems / Holistic and community / Social responsibility / Environment protection / Engineering and technology in systems sciences / Human communication / Application of systems theory to human sciences: praxiology , biology, medicine, psychology, psychiatry, education.

6. APPLICATIONS OF SYSTEMS GENERAL THEORY / 8 HOURS

Open systems / Cybernetics and macro-systems / Complexity / Economy / Ecosystems / Sociology / Politics / Organization / Feasible systems / Chaos theory / Game theory / Operations research / Systems dynamics / Classic science and systems science / Systemic thinking / Soft systems methodology / Ontologic and epistemologic approaches / Human systems.

7. THE ORGANIZATION AND THE SYSTEMIC APPROACH / 8 HOURS

Classic organizational approaches / Cybernetics approach / Human relations approach / The organization as a system / Conceptual models / Systemic model of an organization / Strategic planning / Strategic management / Project management / Quality management / Information and knowledge management / Tendencies.

V. LABORATORIES AND PRACTICAL EXPERIENCES:

Report: Bibliography search on applications of Systems General Theory.

VI. METHODOLOGY

The course is carried out in theory and case analysis. In theory sessions, the instructor introduces concepts, and methodologies. Diverse real-world cases are presented and students teams should defend their analysis. Interactive processes are encouraged incorporating dialogs and open discussions on theoretical and practical aspects based on critical observation of reality. Constructive participation of students is intensively promoted.

VII. EVALUATION FORMULA

The average grade PF is calculated as follows:

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

EP: Mid-term exam EF: Final exam
PP: Average of 8 quizzes and reports.

VIII. BIBLIOGRAPHY

1. **LUDWIG VON BERTALANFFY**
Systems General Theory (Spanish)
Economic Culture Fund Editorial, 2010
2. **CHARLES FRANCOIS**
International Encyclopedia of Systems and Cybernetics
Saur Editorial, Germany, 2004.