



**NATIONAL UNIVERSITY OF ENGINEERING**  
**COLLEGE OF ELECTRICAL AND ELECTRONICS**  
**ENGINEERING**  
**TELECOMMUNICATIONS ENGINEERING PROGRAM**

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**SYLLABUS - EE513 TELECOMMUNICATIONS I**

**I. GENERAL INFORMATION**

<b>CODE</b>	: EE513
<b>SEMESTER</b>	: 6
<b>CREDITS</b>	: 4
<b>HOURS PER WEEK</b>	: 5 (Theory – Practice)
<b>PREREQUISITES</b>	: EE112 Analysis of Electrical Circuits II, MA185 Mathematics V
<b>CONDITION</b>	: Compulsory
<b>INSTRUCTOR</b>	: Virginia Romero, Eladio Jimenez

**II. COURSE DESCRIPTION**

The aim of this course is to provide students with the principles of signals, filters and analog modulation. Likewise, subjects related to Digital signal processing, analog modulation and its corresponding applications in the telecommunication areas will be described and explained. Subjects such as signals, Fourier spectrum, filters, amplitude modulation and demodulation, angular modulation in frequency and phase, discriminators and transmitters-receivers.

**III. COURSE OUTCOMES**

1. Identify, classify and apply energy and power signals in a communication system.
2. Analyze, assess and use analog modulation techniques in the design of reception and transmission systems.
3. Operate transmission and reception equipment modulated in frequency and amplitude.

**IV. LEARNING UNITS**

**1. COMMUNICATION SYSTEMS**

Introduction / Communication systems / Transmission and reception / transmission media / Transmission modes / radio-electric spectrum / Sampling theorem / Analog-to-digital conversion / information theory / Entropy / Practical applications.

**2. LINEAR SYSTEMS**

Linear systems / Linear system response / Distortion-free transmission / Bandwidth / Ideal filters: Low-pass filter, high-pass filter, band-pass filter / Energy / Energy density spectrum in linear systems / Energy in linear systems / Power / Parseval's theorem / Power spectral density / Power spectral density in the input/output of a linear system.

### 3. AMPLITUDE MODULATION

Amplitude modulation / Modulation rate / Power / Efficiency / Multi-tone modulation / Amplitude spectrum / AM signals generation: commutation, nonlinear devices / AM demodulation / Types of demodulators / Double-sideband amplitude modulation (DSB-AM) / Types of modulators / DSB spectrum / Single-sideband modulation (SSB) / SSB spectrum / SSB modulators / Types of independent sideband modulation.

### 4. ANGULAR MODULATION

Angular modulation / Types / Instantaneous frequency / Phase angle / frequency deviation / Modulation rate / Phase modulation: instantaneous phase, phase deviation / Connection between FM and AM / FM narrow / FM wide / Multi-tone FM / Power / Bandwidth / FM stereophonic transmission / Pre-emphasis / Frequency modulation methods: indirect modulation / Direct modulation / Discriminators / Types of discriminators / Phase discriminators / Slope discriminator / Foster Seely discriminator / FM decoders / Matrix system decoders / FM receivers.

## V. LABORATORY EXPERIENCES

**Lab 1:** Instrumentation.

**Lab 2:** Amplitude modulation.

**Lab 3:** Double-sideband modulation.

**Lab 4:** Single-sideband modulation.

**Lab 5:** Frequency modulation.

**Lab 6:** FM discriminators.

## VI. METHODOLOGY

The course is carried out in computing lab, theory and practice sessions. In theory sessions, the instructor introduces concepts, theorems and applications. In practice sessions, several problems are solved, and their solutions are analyzed. In lab sessions, telecommunication modules will be used to acquire practical experiences of AM and FM analog modulation. Optionally, it will be complemented with simulations using Matlab software.

## VII. EVALUATION FORMULA

The average grade PF is calculated as follows:

$$PF = (EP+EF+((P1+P2+P3+P4)/4+(L1+L2+L3+L4+L5+L6)/6)/2)/3$$

EP: Mid-Term Exam

EF: Final Exam

P#: Quizzes

L#: Labs

## VIII. BIBLIOGRAPHY

### 1. LEON W. COUCH II

Analog and Digital Communication Systems (Spanish)  
7<sup>th</sup> Edition. Prentice Hall Editorial, Mexico 2008

### 2. B.P. LATHI

Communication Systems (Spanish)  
Interamerican Editorial, Spain