

## **EC421- Random signals and noise**

### **CREDIT HOURS**

3 Hours

### **CONTACT HOURS (Hours/week)**

Lecture: 2; Tutorial: 2; Lab: 2

### **COURSE COORDINATOR**

Dr. Ashraf Mamdouh

### **TEXT BOOK**

Peyton Z. Peebles, Jr "Probability, Random Variables, and Random Signals", 4<sup>th</sup> edition, McGraw-Hill

### **COURSE DESCRIPTION**

Introduction to communication theory. Fourier transform as a mathematical tool for spectral analysis. Sampling Theory, Convolution of continuous and discrete signals, Correlation, Concept of power and energy spectral densities and correlation between waveforms. Transmission through linear filters and channels. Hilbert transform and Positive pre-envelope and complex envelope. Response of LPF and BPF to signals.

### **PREREQUISITE:**

BA323 - EC321

### **RELATION OF COURSE TO PROGRAM**

Required

### **COURSE INSTRUCTION OUTCOMES**

The student will be able to:

- Identify the importance of probability theory and stochastic processes in the communication systems.
- Revision of analog communication and measure their performance in the presence of noise taking randomness of messages into consideration and, SNR calculations for each of the possible detection methods of the analog communication systems.
- Revisit the digital modulation system and measure their performance in the presence of noise

### **TOPICS COVERED**

- Review of probabilities, R.V., characteristics function, joint R.V., correlation, independence.
- Transformation of random variables (cont.) + review of random processes
- Random processes: Autocorrelation, PSD, Stationarity, Ergodicity
- AWGN channels and band-pass noise- I-Q representation of Bandpass noise
- Performance of Linear Modulation: Coherent detectors, AM noncoherent detection in the presence of noise.

- Performance of Exponential Modulation in the presence of Noise: PM detection in the presence of noise FM performance in the presence of noise.
- Optimum pre-emphasis and de-emphasis systems. Discrimination between NBFM and WBFM on noise performance basis.
- Performance of Analog Pulse Modulation in the presence of Noise: PAM
- Noise performance of PWM and PPM. Bandwidth noise reduction.
- Quantization error. SQNR, Performance of PCM in the presence of Noise- Probability of Error.
- Matched filter Theory- White noise- Colored noise. Correlation receivers.
- Performance of PCM with Matched Filter receivers.
- Power Spectral Density and spectral efficiencies of PCM waveforms.
- Intersymbol Interference (ISI): Concept, and pulse shaping techniques: Nyquist pulse, raised cosine pulse, Duobinary signaling
- Performance of FDM and TDM in noise.

**CONTRIBUTION OF COURSE TO MEET THE REQUIREMENTS OF CRITERION 5:**

<b>Professional component Content</b>			
<b>Math and Basic Sciences</b>	<b>Engineering Topics</b>	<b>General Education</b>	<b>Other</b>
✓	✓		

**RELATIONSHIP OF COURSE TO STUDENT OUTCOMES:**

<b>Student Outcomes</b>		<b>Course aspects</b>
A	An ability to apply knowledge of mathematics, science, and engineering	a <sub>1</sub> a <sub>2</sub>
B	An ability to design and conduct experiments, analyze and interpret data.	b <sub>1</sub> b <sub>2</sub> b <sub>3</sub> b <sub>4</sub>
C	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economics, environmental, social, political, ethical, health, and safety, manufacturability, and sustainability	
D	An ability to function on multi-disciplinary teams.	
E	An ability to identify, formulate, and solve engineering problems	e <sub>1</sub> e <sub>2</sub> e <sub>3</sub>
F	An understanding of professional and ethical responsibility	
G	An ability to communicate effectively	
H	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social content	
I	A recognition of the need for, and an ability to engage in life-long learning.	
J	A knowledge of contemporary issues within and outside the electrical engineering profession.	
k	An ability to use the techniques, skills, and modern engineering tools necessary for electrical engineering practice.	k