The University of Jordan
School of Engineering
Electrical Engineering Department
2nd Semester – A.Y. 2020/2021

Course: **Communications (I) – 0953421 (3 Cr. – Required Course)**

Instructor: Prof. Mohammed Hawa
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Office Hours: Will be posted soon

Course website: http://www.hawa.work/421

Catalog description: Continuous-wave (CW) modulation: Amplitude Modulation (AM), Frequency Modulation (FM) and Phase Modulation (PM). Bandwidth estimation. AM and FM transmitters and receivers. Noise sources and noise representation in CW modulation. Signal-to-Noise Ratio (SNR). Frequency Division Multiplexing (FDM) and Time Division Multiplexing (TDM). Introduction to baseband transmission: line coding, pulse shaping, PAM, PWM, PPM and Pulse Code Modulation (PCM). Introduction to digital modulation techniques: ASK, FSK, PSK and QPSK. Performance of digital modulation schemes in the presence of noise.

Prerequisites by course:

EE	**0953221**	Signal Analysis & Systems	(pre-requisite)
EE	**0953321**	Probability and Random Variables	(pre- or co-requisite)

Prerequisites by topic: Students are assumed to have a background in the following topics:
- Continuous-time signal analysis, Fourier series and Fourier transform.
- Filters and the difference between the LPF, HPF and BPF.
- Using MATLAB and other circuit simulation software.

Textbook: **Modern Digital and Analog Communications Systems by B. P. Lathi and Zhi Ding, Oxford University Press, 5th Edition, 2018.**

References:

1. Fundamentals of Communication Systems by John G. Proakis and Masoud Salehi, Prentice Hall, 2nd Edition, 2013.
2. Analog and Digital Communications (Schaum's Outlines) by Hwei P. Hsu, McGraw-Hill, 2nd Edition, 2002.
3. Digital and Analog Communication Systems by Leon W. Couch, Prentice Hall, 8th Edition, 2012.
4. An Introduction to Digital and Analog Communications by Simon Haykin and Michael Moher, Wiley, 2nd Edition, 2006.
5. Analog and Digital Communication Systems by Martin S. Roden, Discovery Press, 5th Edition, 2003.

6. Digital Communication Systems by Simon Haykin, Wiley, 1st Edition, 2013.
7. Contemporary Communication Systems using MATLAB by John G. Proakis, Masoud Salehi and Gerhard Bauch, Thomson-Engineering, 3rd Edition, 2012.

Schedule: 16 Weeks, 42 lectures (50 minutes each) plus exams.

Course goals: The overall objective is to introduce the student to the basics of communications theory. This course emphasizes:
- Analog modulation and demodulation techniques.
- Performance evaluation of communication systems in the presence of noise.
- Modern trends in communication systems and transmitter/receiver circuits.

Course learning outcomes (CLO) and relation to ABET student outcomes (SO):

Upon successful completion of this course, a student will:		[SO]
1.	Understand the theory behind amplitude, frequency and phase modulation techniques.	[1]
2.	Become familiar with the performance measures used in conjunction with communication systems including required channel bandwidth and signal-to-noise ratio (SNR).	[1]
3.	Be able to analyze the design of AM and FM transmitters and receivers.	[1]
4.	Learn how FDM and TDM multiplexing systems work.	[1]
5.	Become familiar with the digital modulation techniques: ASK, FSK, PSK & QPSK.	[1]
6.	Be able to identify design issues in contemporary communication networks, such as: satellite systems, landline and cellular telephony, wireless networks, television and radio broadcasting systems, etc.	[1]

Course topics:		Hrs
1.	Channel impairments: attenuation, distortion and noise. Noise sources/characteristics.	3
2.	Classification of communication systems (analog and digital, baseband and carrier). Communication system block diagram.	2
3.	(Handout) Signal Analysis Review: time and frequency domains, Fourier series and transform, spectral densities, RMS, average power, dBm levels, filters.	3
4.	Double Sideband Suppressed Carrier (DSB-SC) Modulation/Demodulation. Mixers, coherent detection and frequence/phase errors. Circuits: Gilbert Cell, Switching modulator/demodulator.	5
5.	Quadrature Amplitude Modulation (QAM) and Vestigial Sideband (VSB). Analog TV broadcasting standards.	2
6.	Frequency conversion (heterodyning).	1
7.	(Handout) Introduction to baseband digital transmission: sampling of signals, quantization, adptive quantization, line coding and pulse shaping.	3
8.	AM Modulation/Demodulation. AM modulation index and power efficiency. Circuits: Modulators, envelope detector, synchronous detector.	1
9.	Frequency division multiplexing (FDM) and FDMA. The Superheterodyne receiver. AM radio broadcasting.	5

10.	Noise representation (AWGN noise). Performance of analog communication systems in the presence of noise, Signal-to-Noise Ratio (SNR) for DSB-SC and AM.	**2**
11.	Frequency Modulation (FM) and Phase Modulation (PM): time-domain representation, bandwdith estimation (Carson's rule), Narrowband and Wideband FM, FM and PM advantages/disadvantages and applications. SNR of FM signals. FM radio broadcasting.	**3**
12.	Oscillators. FM/PM transmitters/receivers: VCO, tuned circuit discriminators, Phase Locked Loops (PLL), phase detectors.	**1**
13.	Time division multiplexing (TDM) and TDMA. Telephony and Pulse Cod Modulation (PCM).	**6**
14.	(Handout) Introduction to Digital Modulation techniques: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Quadrature Phase Shift Keying (QPSK) and Quadrature Amplitude Modulation (QAM). Performance Analysis.	**2**

Ground rules: Attendance is required and highly encouraged. To that end, attendance will be taken every lecture. Eating and drinking are not allowed during class, and cell phones must be set to silent mode. All exams (including the final exam) should be considered cumulative. Exams are closed book. No scratch paper is allowed. You will be held responsible for all reading material assigned, even if it is not explicitly covered in lecture notes.

Assessment & grading policy:

Assignments	0%	Quizzes	0%
First Exam	30%	Projects	0%
Midterm Exam	30%	Lab Reports	0%
Final Exam	40%	Presentation	0%
		Total	**100%**

Last Revised: March 2021