The University of Jordan
School of Engineering
Electrical Engineering Department
1st Semester – A.Y. 2018/2019

Course: Communications I – 0903421 (3 Cr. – Core Course)

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

Catalog data: 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 0903221 – Signal Analysis** (pre-requisite), and
EE 0903321 – Probability and Random Variables (pre-requisite 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, 4th Edition, 2009.**

References:
- *Digital and Analog Communication Systems* by Leon W. Couch, Prentice Hall, 8th Edition, 2012.
- *Introduction to Communication Systems* by Ferrell G. Stremler, Prentice Hall, 3rd Edition, 1990.
- *Schaum's Outline of Theory and Problems of Analog and Digital Communications* by Hwei P. Hsu, McGraw-Hill, 2nd Edition, 2002.
- *An Introduction to Digital and Analog Communications* by Simon Haykin and Michael Moher, Wiley, 2nd Edition, 2006.
- *Fundamentals of Communication Systems* by John G. Proakis and Masoud Salehi, Prentice Hall, 2nd Edition, 2013.
- *Digital Communication Systems* by Simon Haykin, Wiley; 1st Edition, 2013.
- *Contemporary Communication Systems using MATLAB* by John G. Proakis, *et. al.*, Thomson-Engineering, 3nd Edition, 2012.

Schedule & duration: 16 Weeks, 41 lectures (50 minutes each) plus exams.

Minimum student material: Textbook, class handouts, scientific calculator, and an access to a personal computer.

Minimum school facilities: Classroom with whiteboard and projection display facilities, library, computational facilities with MATLAB and an EM/Circuit Simulation program.

Course objectives: 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 and relation to ABET student outcomes:

Upon successful completion of this course, a student should:

1. Understand the theory behind amplitude, frequency and phase modulation techniques. [a, e]
2. Become familiar with the performance measures used in conjunction with communication systems including required channel bandwidth and signal-to-noise ratio (SNR). [a, e, k]
3. Be able to analyze and design AM and FM transmitters and receivers. [a, e]
4. Learn how FDM and TDM multiplexing systems work. [e, j]
5. Become familiar with the digital modulation techniques: ASK, FSK, PSK and QPSK. [a, e, j]
6. Be able to identify modern trends and design issues in contemporary communication networks: Cellular telephony, Landline telephony, Wireless networks, Ethernet, TV, etc. [j, k]

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 (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.	**First Exam.**	**1**
9.	AM Modulation/Demodulation. AM modulation index and power efficiency. Circuits: Modulators, envelope detector, rectifier detector, synchronous detector.	**5**
10.	Frequency division multiplexing (FDM) and FDMA. The Superheterodyne receiver. AM radio as an example.	**2**
11.	Noise representation (AWGN noise). Performance of *analog* communication systems in the presence of noise, Signal-to-Noise Ratio (SNR) for DSB-SC and AM.	**3**
12.	**Midterm Exam**.	**1**
13.	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 and stereo FM.	**6**
14.	Oscillators. FM/PM transmitters/receivers: VCO, tuned circuit discriminators, Phase Locked Loops (PLL), phase detectors.	**2**
15.	Time division multiplexing (TDM) and TDMA. Telephony and Pulse Cod Modulation (PCM).	**1**
16.	The concept of Estimation and Prediction: Differential PCM.	**1**
17.	**(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. 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.

Assessments: Exams, Quizzes, Projects, and Assignments.

Grading policy:

First Exam		**30 %**
Midterm Exam		**30 %**
Final Exam		**40 %**
	Total	**100%**

Last Updated: September 2018