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<b>Course:</b>	Communications I – 0903421 (3 Cr. – Core Course)
<b>Instructor:</b>	Dr. Mohammed Hawa Office: E306, Telephone: 06/5355000 ext 22857, Email: hawa@ju.edu.jo Office Hours: will be posted soon
<b>Course Website:</b>	<a href="http://www.hawa.work/421">http://www.hawa.work/421</a>
<b>Catalog Data:</b>	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.
<b>Prerequisites by Course:</b>	<b>EE 0903221 – Signal Analysis</b> (pre-requisite), and EE 0903321 – Probability and Random Variables (pre-requisite or co-requisite)
<b>Prerequisites By Topic:</b>	Students are assumed to have a background in the following topics: <ul style="list-style-type: none"><li>• Continuous-Time signal analysis, Fourier series and Fourier transform.</li><li>• Filters and the difference between the LPF, HPF and BPF.</li><li>• Using MATLAB and other circuit simulation software.</li></ul>
<b>Textbook:</b>	<b>Modern Digital and Analog Communications Systems by B. P. Lathi and Zhi Ding, Oxford University Press, 4th Edition, 2009.</b>
<b>References:</b>	<ul style="list-style-type: none"><li>• <i>Digital and Analog Communication Systems</i> by Leon W. Couch, Prentice Hall, 8th Edition, 2012.</li><li>• <i>Introduction to Communication Systems</i> by Ferrell G. Stremler, Prentice Hall, 3<sup>rd</sup> Edition, 1990.</li><li>• <i>Schaum's Outline of Theory and Problems of Analog and Digital Communications</i> by Hwei P. Hsu, McGraw-Hill, 2<sup>nd</sup> Edition, 2002.</li><li>• <i>An Introduction to Digital and Analog Communications</i> by Simon Haykin and Michael Moher, Wiley, 2<sup>nd</sup> Edition, 2006.</li><li>• <i>Fundamentals of Communication Systems</i> by John G. Proakis and Masoud Salehi, Prentice Hall, 2<sup>nd</sup> Edition, 2013.</li><li>• <i>Digital Communication Systems</i> by Simon Haykin, Wiley; 1st Edition, 2013.</li><li>• <i>Contemporary Communication Systems using MATLAB</i> by John G. Proakis, et. al., Thomson-Engineering, 3<sup>rd</sup> Edition, 2012.</li></ul>
<b>Schedule &amp; Duration:</b>	16 Weeks, 41 lectures (50 minutes each) plus exams.
<b>Minimum Student</b>	Textbook, class handouts, scientific calculator, and an access to a personal computer.
<b>Material:</b>	
<b>Minimum College</b>	Classroom with whiteboard and projection display facilities, library, computational facilities with MATLAB and an EM/Circuit Simulation program.
<b>Facilities:</b>	
<b>Course Objectives:</b>	The overall objective is to introduce the student to the basics of communications theory. This course emphasizes: <ul style="list-style-type: none"><li>• Analog modulation and demodulation techniques.</li><li>• Performance evaluation of communication systems in the presence of noise.</li><li>• Modern trends in communication systems and transmitter/receiver circuits.</li></ul>

## 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:

	Topic Description	Hrs
1.	<i>Channel</i> impairments: attenuation, distortion and noise. Noise sources/characteristics.	3
2.	Classification of communication systems ( <i>analog</i> and <i>digital</i> , <i>baseband</i> and <i>carrier</i> ). Communication system block diagram.	2
3.	<b>(Handout)</b> Signal Analysis Review: <i>time</i> and <i>frequency</i> 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 frequency/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.	<b>(Handout)</b> Introduction to baseband digital transmission: sampling of signals, quantization, adaptive quantization, line coding and pulse shaping.	3
8.	<b>First Exam.</b>	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 <i>analog</i> communication systems in the presence of noise, Signal-to-Noise Ratio (SNR) for DSB-SC and AM.	3
12.	<b>Midterm Exam.</b>	1
13.	Frequency Modulation (FM) and Phase Modulation (PM): time-domain representation, bandwidth 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.	<b>(Handout)</b> 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 2017