SONOMA STATE UNIVERSITY | Department of Engineering Science Electrical Engineering

EE 442

1. **Course Number & Name:** EE 442, Analog and Digital Communication Systems
2. **Course Credit and Contact Hours:** 3 Units, 3 hours
3. **Course Coordinator:** Dr. Donald Estreich
4. **Textbook:** Samuel O. Agbo & Matthew N. O. Sadiku, *Principles of Modern Communication Systems,* Cambridge University Press, Cambridge, U.K. 2017.ISBN 978-1-107-10792-2
5. **Supplemental Materials:** Handouts on selected topics
6. **Specific Course Information:**
   a. **Description:** Mathematical modeling of signals, time and frequency domain concepts, spectral density, components of a communications system, analog signal transmission; Analog modulation and demodulation techniques, FDM, noise and bandwidth; Digital signals and their transmission, PCM and low bit rate coders, TDM; data encoding for efficient baseband digital transmission, digital data modulation. Laboratory work consistent with the lecture topics covered.
   b. **Prerequisites:** EE 230, EE 400, or consent of instructor
   c. **Co-Requisite:** None
   d. **Status:** ☑ Required for EE program, ☐ Elective, ☐ Selected Elective
7. **Specific Goals for the Course:**
   a. **Specific outcomes of instruction:** Upon successful completion of this course the students will be able to:
      i. Explain the differences between analog and digital communication systems and compare their respective advantages and disadvantages
      ii. Understand signal multiplexing, modulation and demodulation; bandwidth requirements; signal power spectrum requirements for analog and digital communication systems.
      iii. Apply signal and system analytical tools in both the time and frequency domains; including Fourier transforms, frequency response functions, time duration versus bandwidth, and convolution.
      iv. Understand amplitude, phase and frequency modulation and demodulation and how they compare.

v. Application of the Sampling theorem to analog-to-digital conversion and understand the limitations of practical sampling, quantization and encoding.

vi. Understand the basic operation of spread spectrum communication systems using both direct sequence and frequency hopping approaches to spread spectrum with examples of current systems.

vii. Gain an appreciation for modern communication systems such as 2G, 3G and 4G cellular wireless communication systems.

b. This course supports the following ABET Student Outcomes:

i. SO-1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

8. Brief List of Topics to be Covered:

a. Definition of Communication Systems; Shannon-Weaver Model
b. Review of Fourier Series and Transform; Important transform pairs; power spectra density
c. Signal transmission over various channels; AWGN; interference; fading; filtering
d. Amplitude Modulation; modulation and demodulation; DSB-SC; SSB; QAM
e. AM demodulation techniques; slope detection, etc.
f. Carrier acquisition techniques (squaring, PLL, example of Costas loop); FDM
g. Superheterodyne receivers
h. Angle (phase and frequency) modulation; bandwidth and signal requirements; noise immunity
i. Narrowband and Wideband FM; Armstrong's FM generation; Direct method FM generation
j. Sampling theorem (sample, quantize and encode)
k. Digital carrier systems: ASK, PSK, FSK, QPSK; I/Q modulation; M-ary signaling
l. PSD; eye diagrams; Bit error rate
m. Multiple access technology (FDMA, TDMA, CDMA, SDMA)
n. Spread spectrum (DSSS and FHSS); examples in Wi-Fi and Bluetooth
o. OFDMA and MIMO
p. Cellular networks (2G, 3G, 4G); The development in 5G (massive MIMO, new bands)