Course Name: Advance Communication Theory
Course Number: EE - 503
Credits: 3-0-0-3
Prerequisites: IC210: Probability, Statistics and Random Processes
EE 304: Communication Theory or the instructor's consent
Intended for: B.Tech./ MS/ M.Tech./ Ph.D.
Distribution: Elective for EE and CSE (Specialization basket course for M.Tech. CSP)
Semester: Odd

Learning outcome: After taking this course, students will be

1. Familiar with different types of modulation schemes that are commonly used in modelling communication systems and their benefits.
2. Able to devise optimum receivers/ detection schemes associated with different communication scenarios.
3. Able to compare the performance of different communication schemes/systems in terms of their error probabilities.
4. Able to devise different equalization techniques considering different signaling schemes for communication channels with AWGN, and ISI.
5. Able to identify the role of multichannel and multicarrier systems along with their challenges, e.g., channel coding, power allocation, and PAPR.
6. Able to better understand the communication system by verifying the theoretical performance of the techniques taught in class via simulation.

Course modules:

1. *Digital modulation schemes:* (12 contact hours)
   Bandpass and lowpass signal representation, Digital modulation schemes (PAM, PM, QAM, Multidimensional Signals, CPFSK, CPM) and their corresponding optimal receivers and error probabilities for AWGN Channel.
2. *Carrier and Symbol Synchronization:* (8 contact hours)
   importance in signal demodulation, carrier frequency and phase estimation – decision directed and power of N methods, timing estimation - spectral-line, MMSE, and ML methods, joint carrier and symbol synchronization.
3. *Equalization:* (12 contact hours)
   Optimal zero-forcing equalization, Linear, Decision-feedback, Adaptive Linear, Adaptive Decision-feedback, and Blind equalization.
4. *Multichannel and Multicarrier Systems:* (8 contact hours)
   AWGN multichannels, Multicarrier communications: OFDM – modulation and demodulation, spectral characteristics, bit and power allocation, channel.
5. *Case Studies:* (3 contact hours)
   A brief overview of modern communication/broadcast technologies.

Text Books:

1. J. G. Proakis and M. Salehi, Digital Communications, 5/e, McGraw-Hill, Prentice Hall, 2007.
2. R. G. Gallager, Principles of Digital Communication, Cambridge Univ. Press, 2008.

Reference Books:

1. B. Sklar, Digital Communications: Fundamentals and Applications, 2/e, Prentice Hall, 2001.
2. John R. Barry, David G. Messerschmitt, and Edward A. Lee, *Digital Communication: Third Edition*. Kluwer Academic Publishers, 2003.
3. A. Lapidoth, A Foundation in Digital Communication, Cambridge Univ. Press, 2009.
4. Simon Haykin, *Digital Communications*. Wiley Publishing, 2006.