

# ELEC 5705 RF System Design

Carleton University, Monday, 2:30-5:30, January - May, 2021

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Description: *System level design of a typical integrated radio. System architectures for radio front ends. Detailed design procedures going from a radio specification to determine block level specifications: determining NF, EVM, phase noise, linearity from BER and radio range requirements.*

Pre-requisites: *An undergraduate degree in electrical engineering*

Grading Scheme: *70% assignments, 30 % Final*

Text: Radio Frequency System Architecture and Design by John Rogers, Calvin Plett and Ian Marsland  
References: RF System Design of Transceivers for Wireless Communications by Qizheng Gu  
Practical Digital Wireless Signals by Earl McCune  
Radio Frequency Integrated Circuit Design 2<sup>nd</sup> Ed. By John W. M. Rogers and Calvin Plett  
Integrated Circuit Design for High Speed Frequency Synthesis by John Rogers, Calvin Plett and Foster Dai  
Digital Communications by Bernard Sklar

Week-by-week Description:

*Week 1: Introduction and Motivation.  
Weeks 2 and 3: A review of noise, phase noise, linearity  
Week 4: A study of modulation schemes including PSK, QAM and OFDM.  
Weeks 5 and 6: RF System architectures such as direct down conversion and superheterdyne radios.  
Weeks 7, 8, and 9: Study of communication links. Study of radio specifications such as EVM, phase noise, frequency planning, noise figure, linearity, gain and AGC considerations. This will include how to specify the performance of both the receiver and transmitter.  
Weeks 10, 11, and 12: A study of system level synthesizer specifications including a study of classic PLL as well as ADPLL architectures. Review and exam preparation.*

Rationale:

*In the department of electronics we spend a lot of effort training circuit designers, especially in the area of high speed analog design. These designers often work on designing individual radio blocks to meet specifications such as IIP3, noise figure or phase noise without having any idea where these specifications came from. This course will attempt to enlighten block level designers as to why their blocks need to meet certain specifications in order for the overall radio to function properly.*