Ultra Wide Band (UWB) Radio Fundamentals
Second Year, M.Sc. in Communications and Electronic Engineering (First semester)
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Course material**:** *Available on the course webpage at http://acts.ing.uniroma1.it/~lucadn/uwb.php*

- Ultra Wide Band radio [2 hours]
  - Definition
  - IEEE and industrial standards: IEE 802.15.4a, UWB Alliance, Wireless USB, IEEE 802.15.4z

- Generation of UWB signals [6 hours]
  - Impulse Radio (IR): Time-hopping UWB, Direct-Sequence UWB
  - Continuous waveform: Multi-Band UWB signals
  - UWB signals in the TeraHertz band

- Power Spectral Density of UWB signals [4 hours]
  - Time-Hopping UWB
  - Direct-Sequence UWB
  - Multi-Band UWB

- Performance analysis for the UWB radio link [4 hours]
  - Power limits and emission masks.
  - Link budget

- Pulse shaper design for IR-UWB [6 hours]
  - Base pulse
  - Effects of derivation and variation of pulse duration
  - Pulse shaper design as a function of emission masks constraints

- The UWB channel and receiver [6 hours]
  - Propagation of UWB signals over a multipath free AWGN channel and over a multipath affected UWB radio channel
  - The UWB channel model proposed by IEEE 802.15.3a and IEEE 802.15.4a
  - The TeraHertz channel
  - Temporal diversity and RAKE receiver

- Synchronization in IR-UWB communications systems [2 hours]

- Multi User UWB wireless communications [8 hours]
  - Multiple access and multiuser interference
  - Multiuser IR-UWB interference models: Standard Gaussian Approximation and "Pulse collision"
  - Interference models for UWB in the TeraHertz

- Ranging and positioning in UWB systems [12 hours]
  - Ranging based on distance and angle estimation
  - Positioning algorithms
  - Applications: tagging, user tracking and contact tracing with UWB

- Ultra Wide Band networks: Medium Access Control design [2 hours]
  - Medium Access Control (MAC): general principles and functions
  - The 802.15.4/4a MAC protocol

- Experimental platforms [8 hours]
  - The Qorvo development boards
  - MAC and positioning experiments
