

# PhD Syllabus

Department of Electronics and Communication

## Communication theory

Introduction to analog communication system - Amplitude Modulation (AM) – Frequency Modulation (FM) - Phase Modulation (PM) - Multiplexing - Complex low pass representation of narrow band signals and systems - Introduction to random processes - Characterization of noise - Sampling theorem – Quantization- Waveform coding– Baseband and band-pass Digital modulation and demodulation schemes – Digital transmission through AWGN band limited channels – Source coding-Information theory - Error correction codes. Data Communication Concepts – OSI model.

## Digital and embedded Systems

Combinatorial circuits, sequential circuits, number representation – fixed and floating point, FPGAs; computer architecture – data representation, addressing modes, ALU, CPU, pipelining, cache and virtual memory; microcontrollers – ARM, PIC, ATMEGA, USART, I2C, SPI interfaces, assembly language programming; AMBA Bus architectures

## Optics and Photonics

Static Electric Fields - Co-ordinate systems – Basic postulates and theorems in electromagnetics - Electrostatics - Magneto statics - Maxwell's equations – Boundary conditions - Wave equation – Diffraction and interference.

Basic postulates and theorems in electromagnetics - Maxwell's equations – Boundary conditions - Wave equation – transmission lines – impedance matching – waveguides – dielectric waveguides and optical fiber – dispersion and attenuation.

Introduction to Semiconductor materials - Crystal Structure - Review of Quantum Mechanics – E-k diagram - Semiconductor in equilibrium – Carrier transport – pn junction – direct/indirect bandgap – materials for optoelectronics - Optoelectronic devices – Semiconductor device fabrication.

## RF, microwave and antennas

Transmission lines – impedance matching – Waveguides – Transmission Line Resonators - S parameters – S matrix of microwave devices – Effect of mismatch on S-matrix – Antenna Radiation principle – Reflection and radiation characteristics - Radiation from a dipole – monopole and dipole antenna – Antenna arrays – Microstrip Antennas

## Semiconductor technology

Semiconductor materials, crystal structures, quantum mechanics, doping, mobility and conductivity, fermi level, equilibrium carrier concentrations, diffusion and drift, forward and reverse biased pn junction characteristics and properties, band diagrams, MOS capacitor, MOSFET physics, ideal MOSFET characteristics, threshold and sub threshold characteristics, short channel effects, current trends in MOSFET technology, LED physics, Photodetectors, Solar cell concepts, Lasers, optical fibers, waveguides, fabrication technology for ICs - lithography, ion implantation, etching, thin film deposition, interconnects.

## Signal processing

Classification of signals - Basic operations on signals. Systems (continuous/discrete): Representation, classification. LTI systems – differential/difference equation representation, properties, Convolution. Fourier Series - Fourier transform – Sampling - Laplace Transform analysis of systems - Z-Transform - Frequency response of discrete time LTI systems. Filter Design: IIR filters – Butterworth and Chebyshev filters, design methods, transformation to digital filters – impulse invariance and bilinear transformation. FIR filters – design of FIR filters using windowing techniques.