

Course Code	ECE539		
Course Name	Wireless System Implementation		
Credits	4		
Course Offered to	UG / PG		
Course Description	This course will help the students to design and implement a basic wireless communication system. Starting with the large scale propagation models, the students will study the modelling of wireless channel as a linear time varying filter, statistical multipath models and wireless Digital Modulation/ Digital Demodulation techniques. The performance of the digital modulation techniques in Rayleigh fading channel, and with different spatial diversity techniques will also be studied. Moreover, the course will also highlight the trade-off associated between single-carrier and multicarrier (e.g. OFDM) modulation techniques. . The course also involves a hardware (NI USRP) / software (using Matlab) project where the students will validate the theoretical concept studied during lectures		
Pre-requisites			
Pre-requisite (Mandatory)	Pre-requisite (Desirable)	Pre-requisite(other)	
ECE240 Principles of Communication Systems	ECE340 Digital Communication Systems, ECE5xx Principles of Digital Communication	Matlab	
Post Conditions			
CO1	CO2	CO3	CO4
Students are able to analyze the behavior of large scale and small scale wireless propagation models	performance (in Matlab, GNU Radio, LabVIEW) of a wireless communication system in various channel conditions	Students are able to analyze the benefits of multicarrier systems over single carrier systems.	implement a basic wireless communication system using software such as Matlab, GNU Radio or LabVIEW
Weekly Lecture Plan			
Week Number	Lecture Topic	COs Met	Assignment/Labs/Tutorial
1,2,3,4	Review of digital modulation techniques Digital Modulations BPSK, DPSK, QPSK, FSK, QAM Matched Filtering Packet based wireless systems Synchronization Wireless Channel Models Small & Large Scale Fading What causes fading? Large scale fading Types of small-scale fading Multipath impulse response model Parameters characterizing fading channel	C01 C03	Introduction Matlab / Simulink Experiments • Transmitter Random Number generators BPSK/QPSK Modulator Transmit Pulse shaping Filters • Generation of AWGN Channel with Frequency Offset and variable time delay • Receiver Receive Pulse Shaping Filter Coarse and Fine Frequency Compensation Timing Recovery BPSK /QPSK Demodulation • Packet Based Wireless systems Frame Synchronization using Header/Marker3. Simulating a fading channel in Matlab/Simulink • Generating Rayleigh multipath fading channel
5,6,7,8,9	Error Performance of Digital Communications in Noise • Bit error rate • Performance comparison between various modulation schemes in AWGN and Fading channel. Diversity Techniques • Concept of diversity • Types of diversity combining techniques	C01 C02	Matlab / Simulink Experiments • BER Calculator • Monte Carlo Simulations • Plotting and displaying BER curves
10,11	Introduction to software defined radio • Evolution of Radio Hardware • Hardware Subsystem and Software Subsystem • USRP	C04	USRP2 Hardware Experimentation • Implementing BPSK/QPSK Transmitter • Plotting/ Displaying BER for AWGN, LOS and NLOS links
12,13	Multicarrier Transmission Techniques • Orthogonal Frequency division Multiplexing (OFDM) • OFDM with Cyclic Prefix Instructor chosen topic Project Presentations	C02	• Demonstration using OFDM • USRP2 Hardware Experimentation • Implementing OFDM transmitter and receiver
Assessment Plan			
Type of Evaluation	% Contribution in Grade		
Assignment	30		
Final Project	30		
Quizzes and short test	20		
End-Sem	20		
Resource Material			
Type	Title		
Textbook	1. Wireless Communication by Andrea Goldsmith 2. Fundamentals of Wireless Communication by David Tse and Pramod Viswanath		
Journals/ Magazine papers	From IEEE, Open source etc.		