GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (WIRELESS COMMUNICATION SYSTEMS & NETWORKS) (27)
WIRELESS SIGNAL PROPAGATION & FADING
SUBJECT CODE: 2722706
SEMESTER: II

Type of course: Core-IV

Prerequisite: Antenna and Wave Propagation, Probability Theory

Rationale:
Wireless communication systems have to combat transmission and propagation effects that are substantially more hostile than for a wired system. This course aims to teach different propagation path loss models, fading, adaptive modulation and coding schemes, diversity and equalization techniques and MIMO. This course is very important for wireless communication engineers.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
L	T	P	C			ESE	OEP	PA	RP	
4	0	2#	5	70	30	20	10	10	10	150

Content:

Sr. No	Content	Hours	% Weightage
1.	Radio Propagation and Path Loss Models Free space attenuation, attenuation over reflecting surface, effects of earth curvature, radio wave propagation, propagation path loss models (Okumura model, Hata model, COST 231 model), indoor propagation models.	**6**	15
2.	Statistical Multipath Channel Models Time varying channel impulse response, characteristics of wireless channels, signal fading statistics (Rician distribution, Rayleigh distribution, Lognormal distribution) level crossing rate and average duration of fades, wideband fading models (power delay profile, coherence bandwidth, Doppler spread).	**8**	15
3.	Capacity of Wireless Channels Capacity in AWGN, Capacity of flat fading channels, capacity of frequency selective channels, time invariant channels, time varying channels.	**7**	10
4.	Adaptive Modulation and Coding Adaptive transmission systems, adaptive techniques (variable rate technique, variable power, variable error probability, variable coding technique, hybrid techniques.	**6**	15
5.	Diversity and Equalization Techniques Realization of independent fading paths, receiver diversity, transmitter diversity, equalizer noise enhancements, equalizer types, folded spectrum and ISI free transmission, linear equalizers, adaptive equalizers.	**8**	15

6.	Multicarrier Modulation Data transmission using multiple carriers, mitigation of subcarrier fading, discrete implementation of multicarrier modulation, OFDM, challenges in multicarrier modulation.	**6**	15
7.	Multiple Antennas and Space Time Communications MIMO channel capacity, MIMO diversity gain, Beam forming, diversity-multiplexing trade-off, space time modulation and coding, frequency selective MIMO channel, smart antennas.	**7**	15

Reference Books:

1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
2. Fundamental of Wireless Communication : David Tse , Pramod Vishwanath , Cambridge Press
3. Space Time Coding Theory & Practice : Hamid Jafarkhani, Cambridge University Presss
4. Space Time Block Coding for Wireless Communications : Erik G. Larsson, Petre Stoica, Cambridge University Press

Course Outcomes:

After learning the course the students should be able to:

- Describe the concepts and issues related to wireless signal propagation
- Write programs for channel capacity for various channel conditions
- Understand OFDM and challenges in multicarrier modulation
- Learn diversity and equalization techniques
- Perform comparisons and evaluate performance of various modulation and coding techniques and know importance of adaptive modulation and coding
- Perform literature searches, and computer simulation for MIMO systems
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List of Experiments:

1. Wireless Path loss Computations -Study of Propagation Path loss Models: Indoor & Outdoor (Using Matlab Programming)
2. To observed statistical characteristic of wireless multipath channel models in MATLAB
3. To analysis of multipath fading reception (Fast and slow)
4. To define channel capacity algorithm and measure the channel capacity
5. To generate channel matrix H with different fading distributions
6. To find out SVD for channel matrix H

Open Ended Problems:

Design new channel capacity measurement algorithm very power full in power allocation in different sub channels

Major Equipment:

1. Agilent E4438C Vector Signal Generator
2. Agilent 8720ES Network Analyzer
3. Agilent N8975A Noise Figure Analyzer
4. Wireless Module (Tx and Rx)

List of Open Source Software/learning website:

MATLAB, Network Analyzer Emulator

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website