GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (SIGNAL PROCESSING & COMMUNICATION)
(41)
ADVANCES IN WIRELESS COMMUNICATION
SUBJECT CODE: 2724110
SEMESTER: II

Type of course: Advance level course in wireless communication

Prerequisite: Digital communication

Rationale: The course aims to train the students with advance topics in communications.Various multiple access technique and fading needs to be well understood by the students. MIMO communication concepts are required to be studied by the students which are incorporated in the course. The course aims to have related simulations and experimentation for students to validate the theory studied.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% weightage
1	**Introduction to wireless communication :** Background of communication systems, the physical layer, data-link layer FDMA, TDMA, CDMA, SDMA	3	10
2	**Propagation and Noise:** Local Propagation effects with Mobile radio, Channel Classification, Noise and Interference , Link Calculation (Free space link Budget and Terrestrial link Budget), Design examples,	10	20
3	**Spread Spectrum and Code Division Multiple Access:** Introduction, Direct –Sequence Modulation, Spreading Codes, Advantages of CDMA, Code Synchronization , Channel Estimation, power control the near far problem, FEC coding , multiuser detection, CDMA in Cellular Environment, Frequency hopped spread spectrum, Design examples of IS-95, GPSS, Bluetooth, W-CDMA, Wi-Fi	20	35
4	**Diversity, Capacity and Space –Division Multiple Access:**Introduction, Space Diversity on Receive" techniques, MIMO Antenna Systems, MIMO Capacity estimation, Singular value de-composition of the channel matrix, Space-Time codes for MIMO wireless communication, differential space-time block codes, Space division multiple access and smart antennas, Design Examples of various BLAST architecture, Diversity, Space-time block codes, V-	20	35

	BLAST, Keyhole Channel		

Reference Books:

1. Simon Haykin, Michale Moher, "Modern Wireless Communications", Pearson.
2. Xiaodong Wang, H. Vincent Poor, "Wireless Communication Systems: Advanced Techniques for Signal Reception", Pearson.
3. Theodore S. Rappaport, "Wireless Communications: Principles and Practice" Second Edition, Pearson Education

Course outcomes:

After learning the course the students should be able to understand various bandwidths efficient and power efficient wireless communication techniques. The fundamental physical resource of any wireless communication is "Radio Spectrum". Researchers and Developers have been often in the search of various methods to use this resource efficiently. This course given in detail knowledge of basics and working principles of existing efficient communication techniques which uncovers many research areas in wireless communication.

List of Experiments:

1. To study analysis of various Digital modulation techniques.
2. To Study and analysis of fading channels.
3. Comparisons of digital modulation techniques in multipath environment
4. To study forward error correction coding technique.
5. To study and analysis of various outdoor propagation models.
6. To study and analysis of different types of noise in wireless communication systems.
7. To study Direct –Sequence Spread spectrum communication system.
8. To study frequency hopped spread spectrum communication system.
9. To study MIMO based communication Systems.
10. To study Channel estimation algorithms.
11. To study BLAST architecture

Open Ended Problems:
1. Formulate the path loss equation from the empirical measurements in a particular environmental condition (Indoor or Outdoor). Specify the all technical specification of the wireless communication used to formulate path loss.
2. Design any analog/digital wireless communication system with noise and link budget computation.
3. Verify the critical distance concept in real time and suggest any modification in the equation if required.
4. Design and analyze new energy efficient digital modulation scheme for any wireless communication system.
5. Design and analyze new Bandwidth efficient digital modulation scheme for any wireless communication system.
6. Design and analyze new secure and energy efficient encryption/Decryption algorithm for wireless communication system.
7. Design and analyze any MIMO Communication system and prove the advantages of MIMO system over SISO, SIMO,MISO with a case study.
8. Implement direct sequence spread spectrum transmitter using BPSK modulation technique.
9. Implement frequency hopped spread spectrum transmitter.

10. Design and analyze any communication channel estimation algorithm.
11. Propose a novel diversity method with all technical analysis.

Major Equipments and Software:

Matlab,
NI LabVIEW
Spectrum Analyser,
Frequency Synthesizer,
 RF Transmitter/Receiver system

List of Open Source Software/learning website:

1. http://www.sss-mag.com/
2. www.agilent.co.in(Application Notes)
3. http://www.itu.int

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