First Course Handout

Wireless Communication

E-masters in Communication Systems

Department of Electrical Engineering

Indian Institute of Technology Kanpur

1. Objectives:

The course has both theoretical and practical flavors. It aims to explain the fundamental concepts and insights behind the development of modern 4G/ 5G wireless communication technologies. As part of the course, precise analytical models will be presented for various wireless systems followed by detailed performance analysis. The course intends to cover several key 4G/ 5G wireless technologies such as **OFDM, MIMO, MIMO-OFDM** in significant detail. This will also lay the foundation for advanced wireless communication techniques.

2. Prerequisites:

Students are expected to be familiar with basic concepts of

- Probability, Random Variables and Random Processes
- Linear Algebra, Properties of Matrices etc.
- Calculus, differentiation, integration

3. Course Contents:

S.No	Broad Title	Topics	Number of Lectures
1	Wireless Communications and	AWGN channel modeling, SNR concept and BER performance for	4

		BPSK, QPSK and higher order modulations	
2	Digital communication system models	Fading channel models, BER analysis, Deep fade	4
3	Diversity in Wireless Systems	Multiple antenna systems, Beamforming and diversity concepts	4
4	Multiple Input Multiple Output (MIMO) Technology Receivers	MIMO Technology, Linear Receivers ZF, MMSE and performance	4
5	MIMO Technology and Optimization, Space Time Codes	SVD, Precoding/ Combining in MIMO, Optimal Power Allocation, Space Time Block Codes	4
6	Orthogonal Frequency Division Multiplexing (OFDM) technology	Single carrier vs. Multicarrier implementation, IFFT/ FFT receivers in OFDM, Cyclic prefix and circular convolution	4
7	MIMO OFDM Technology	MIMO OFDM system model, transmission/ reception and receiver structure	4
8	Wireless channel modeling	Wireless channel models, delay spread, frequency selective/ frequency flat channels, mobility and Doppler modeling	4

4. Special Emphasis:

- Fading channel modeling, Deep fade
- Diversity, Multi-Antenna Systems
- MIMO Technology
- OFDM Technology
- MIMO-OFDM Technology

5. Live Interaction:

- Sunday 12 noon via zoom.
- Students can also contact both instructor as well as TAs via e-mail.

6. Evaluation Components & Policies:

	Weightage
Assignments (Theory)	10%

Quiz-I	10%
Quiz-II	10%
Quiz-III	10%
End-Sem	50%
Attendance Minimum 80% attendance	10%

Exam/ Assignment/ Term Paper Policy:

If a student misses any one or more of Quiz-I/ Quiz-II/ Quiz-III, marks will be pro-rated based on remaining ones, if valid reason is provided along with supporting documents. If a student misses the end-sem exam, he/ she can apply to DOAA for makeup examination. No makeup or prorating will be done for missed assignment submissions.

7. Course Policies: Attendance, Honesty Practices, Withdrawal (within the limits of DOAA Guidelines)

Attendance Policy: Minimum 80% attendance is required to score the 10% marks specified for attendance as per **Evaluation Policies** in Section 7. Attendance will be recorded in every session.

All participants MUST keep their video feed ON during the live interaction to monitor attendance and participation.

Students are expected to observe a **personal code of honesty** in submission of assignment solutions, quizzes and exams. This will be based on honor code. 25% marks will be deducted for plagiarism or copying.

8. Books & References: Properly Formatted along with listing of possible internet sources.

Text Book	
Principles of Modern Wireless Communications	Aditya K. Jagannatham McGraw Hill Education - 2015 http://www.mheducation.co.in/9781259029578-india-principles-of-modern-wireless-communications-systems

Reference Books	
Fundamentals of Wireless Communication	David Tse and Pramod Viswanath Cambridge University Press, 2005 http://www.eecs.berkeley.edu/~dtse/book.html
Wireless Communications	Andrea Goldsmith Cambridge University Press

9. Instructor and TA Information

Instructor	
Prof. Aditya K. Jagannatham	ACES 205D Mailbox on 2nd floor ACES Building. e-mail: adityaj@iitk.ac.in
Course TAs	
Meesam Jafri	meesam@iitk.ac.in