

**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI,
HYDERABAD CAMPUS**

ACADEMIC-GRADUATE STUDIES AND RESEARCH DIVISION

FIRST SEMESTER 2023-2024

Course Handout (Part-I)

Date: 30/07/2023

Course No. : EEE G614

Course Title : Advanced Wireless Communications.

Instructor-in-charge : Dr. Prashant K. Wali

Course Description:

Evolution of wireless cellular technologies, Recap of fundamentals of wireless communications, Coding for Wireless Communications, Multiple Antenna Communications, Beamforming, Diversity, Multiuser Multiplexing, Capacity Analysis, Massive MIMO, channel hardening, channel estimation for MIMO and Massive MIMO, Introduction to Stochastic Geometry for performance analysis of wireless networks, D2D communications- modeling and analysis.

Scope and Objective:

With the exponential increase in the number of mobile devices and the cellular network traffic, the demand for area throughput in wireless networks has increased. Since the area throughput depends on spectral efficiency and cell densification, this course aims to introduce to students the techniques to improve these two quantities.

- a) This course aims to introduce the students to the advances in the wireless communications and expose them to the research options available for applications in the real world implementation of the next generation wireless networks.
- b) The course will introduce the students to current trends in the wireless industry with a specific focus on the 5G communication networks.
- c) The course aims to equip students with tools for designing the engineering aspects of the wireless communications.
- d) New techniques envisaged to be a part of the next generation wireless networks like massive MIMO, D2D communications, NOMA, OTFS and stochastic geometry applied to wireless communications, to name a few, will be covered to make the student industry and research ready.

Text Book(s):

- 1. Andrea Goldsmith, Wireless Communications, Cambridge University Press.
- 2. Thomas L Marzetta, Erik Larsson, Hong Yang and Hein Quoc Ngo, Fundamentals of Massive MIMO.
- 3. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", Wiley, 2015.
- 4. M. Haenggi, Stochastic Geometry for Wireless Networks. New York, NY, USA: Cambridge Univ. Press, 2013.

Reference Book(s):

- 1. Steven Kay, Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory, Prentice Hall.

2. D. Stoyan, W. Kendall, and J. Mecke, Stochastic Geometry and Its Applications, 2nd ed., New York, NY, USA: Wiley, 1987.

Course Plan

Lecture No.	Topic	Learning Objective	Ref. To TB/RB
1	Introduction and Motivation for Advanced Wireless Communication	Area Throughput and ways to increase it.	Text Book [1] Ref [1]
2 - 4	Recap of fundamentals of wireless communications	The Wireless Channel, Point-to-Point Communication: Detection, Time Diversity, Frequency Diversity, OFDM.	Text Book [1]
5-7	4G LTE Technology	4G Physical Layer Frame Structure, OFDM, Traffic Scheduling, Peak Data Rate	Internet Resources.
8-10	Coding for Wireless Communications	Recap of Coding for AWGN channels, challenges in coding for wireless channels. Coding with Interleaving, code design for fading diversity	Text Book [1]
11-30	Multiple Antenna Communications	Directivity, Beamforming, Diversity, Multiplexing, Transmit Diversity, Receive Diversity, MIMO, Point to Point MIMO, MIMO OFDM, Capacity, Multiuser MIMO and capacity region, Massive MIMO.	Text Book [2] and Text Book [1]
31-35	Modulation and multiple access techniques	NOMA, Power Domain NOMA, SCMA, Superposition Coding, SIC, OTFS.	Published papers and Internet Resources. (Will be provided as and when used)
35-42	Introduction to stochastic geometry for performance analysis of wireless networks, D2D communications- modeling and analysis.	Mathematical foundations of Stochastic Geometry, Point Processes, Modeling HetNets and Dense Networks using Stochastic Geometry, Performance Analysis of Wireless Networks, D2D Communications, its modeling and analysis.	Text Book [3] Ref [5], Other published papers and Internet Resources

Evaluation Scheme:

Component	Duration	Weightage	Marks	Date & Time	Evaluation type
Mid sem	90 min	20%	40	11/10 - 11.30 - 1.00PM	Closed Book
Lab		25%	50	-	Open Book
Term Project (Research Paper presentation and extension of ideas + Report)		25%	50	-	Open Book
Compre. Exam.	3 hours	30%	60	12/12 AN	Closed Book
Total			200		

- 5. Chamber Consultation Hour:** To be announced in the class
email: wali@hyderabad.bits-pilani.ac.in
Notices: EEE Notice Board and CMS.

6. Make-up Examination:

Make-up examination will be given only in **extremely genuine cases** for which prior permission of the instructor-in-charge is required.

7. Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**Instructor-in-charge
EEE G 614**