



विद्युत अभियांत्रिकी विभाग  
DEPARTMENT OF ELECTRICAL ENGINEERING  
भारतीय प्रौद्योगिकी संस्थान कानपुर  
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17<sup>th</sup> January, 2020

Dear Prof./ HoD/ Student,

A MATLAB Project Course on the Latest MIMO Technologies for 5G Networks and IoT technologies is being organized by IIT Kanpur from July 27<sup>th</sup> to August 03<sup>rd</sup>, 2020. This course is dedicated to thoroughly covering all the theoretical and practical aspects of the latest 5G technologies such as **Massive MIMO, mmWave MIMO, NOMA, Cooperative Communication, Cognitive Radio and IoT**. The course is focused toward B.Tech/ M.Tech/ Ph.D. students, faculty members and industry personnel interested in learning about different 5G technologies for professional advancement. Participants can work on MATLAB projects on all the 5G technologies and will also be given detailed lecture slides, tutorial assignments, solutions and program code. Special sessions will be conducted to help students prepare for interviews/ competitive exams in ECE and inform about education opportunities available at IITK. All information regarding the course can be found at the website below

<http://www.iitk.ac.in/mwn/latest5G/index.html>

I request you to display the course flyer in your institution. Topics to be covered are listed below

1. Introduction and Key Specs of 5G Technologies
2. Opportunities and Challenges in mmWave MIMO Communication
3. Channel Models for mmWave MIMO Systems
4. Hybrid Signal Processing for mmWave MIMO
5. Digital and Analog Beamforming
6. Hybrid RF/ BB Precoder and Combiner Design for mmWave MIMO
7. Hybrid Transceiver Architectures for mmWave MIMO
8. Sparse Signal Processing and Channel Estimation for mmWave MIMO
9. Optimal Design of Beams and Sensing Matrix for Channel Estimation
10. Overview of MIMO and MU-MIMO Technologies
11. Signal Processing for MIMO Systems
12. Optimal Power Allocation and Precoding for MIMO
13. Introduction to 5G Massive MIMO Systems
14. Key Features of Massive MIMO and Advantages over MU-MIMO
15. Signal Processing Operations for Massive MIMO in UL and DL
16. Massive MIMO Channel Model- Large/ Small Scale Fading
17. Properties of Random Vectors and Massive MIMO Analysis
18. Analysis of Spectral Efficiency in Massive MIMO Systems
19. Pilot Design and Channel Estimation in Massive MIMO Systems
20. Transmitter and Receiver Schemes with Imperfect CSI
21. Spectral Efficiency Analysis of Massive MIMO with Imperfect CSI
22. Massive MIMO with Imperfect CSI and Comparison with Perfect CSI
23. Multi-Cell Massive MIMO Model
24. Channel Estimation with Pilot Reuse and Pilot Contamination
25. New Modulation Schemes for 5G- Spatial Modulation (SM)
26. Space Shift Keying (SSK) and Generalized Spatial Modulation (GSM)
27. Spectral Efficiency Comparison of GSM with Conventional V-BLAST
28. Introduction to Non-Orthogonal Multiple Access (NOMA) Technology
29. Efficiency of NOMA wrto Orthogonal Multiple Access (OMA)
30. Fixed NOMA Protocol for UL/ DL – Performance Analysis
31. Ordered NOMA Protocol and Performance Analysis
32. Optimal Power Allocation for NOMA Systems
33. Cooperative Communication, Optimal Combining
34. BER Analysis and Diversity of Cooperative Communication
35. Optimal Power Allocation with Cooperation
36. Cooperative MIMO communication, Multi-Node Cooperation
37. Introduction to Cognitive Radio Technology, OFDM for CR
38. Spectrum Sensing in Fading Wireless Channels, MIMO, OFDM systems
39. Cooperative Spectrum Sensing, Eigenvalue based Spectrum Sensing
40. Multi-User Transmission in Interweave CR Systems
41. MIMO for Underlay CR Systems
42. Introduction to 5G New Radio (NR) Standard
43. Introduction to 5G NB-IoT Technology
44. Overview of LTE- Cat M1 and Cat NB 1 Standards/ Systems
45. MATLAB Project on mmWave MIMO Channel Estimation
46. MATLAB Project on Hybrid Transceiver Design for mmWave MIMO
47. MATLAB Project on Massive MIMO System Implementation
48. MATLAB Project on New Modulation Techniques for Massive MIMO
49. MATLAB Project on Non-Orthogonal Multiple Access (NOMA)
50. MATLAB Project on Cooperative Communication, Spectrum Sensing

Please do not hesitate to contact us for any further information

Thanking you,

(Prof. Aditya K. Jagannatham)

Professor, IIT Kanpur

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