



विद्युत अभियांत्रिकी विभाग  
DEPARTMENT OF ELECTRICAL ENGINEERING  
भारतीय प्रौद्योगिकी संस्थान कानपुर  
INDIAN INSTITUTE OF TECHNOLOGY KANPUR  
कानपुर- 208 016 (भारत)  
KANPUR - 208 016 (INDIA)

Phone : (0512)-2597409  
2597164  
2597454  
Fax : (0512)-2590063  
Webpage : <http://www.iitk.ac.in/ee>

11<sup>th</sup> September, 2019

Dear Prof./ HoD/ Student,

A 5-Day course on “**Massive MIMO, Cooperative Communication and Cognitive Radio for 5G**” is being organized in **Visakhapatnam** by the Department of Electrical Engineering IIT Kanpur, in association with Andhra University College of Engineering, from **January 6<sup>th</sup> to 10<sup>th</sup>, 2020**. This course will comprehensively cover the various analytical and implementation aspects of the latest *Massive MIMO, Cooperative Communication* and *Cognitive Radio* technologies, which are expected to play a key role in 5G. The course is focused toward B.Tech/ M.Tech students, Ph.D. scholars, faculty and personnel from industry/ R&D establishments interested in pursuing research and practical deployment of 5G technology. In addition to detailed lecture slides, tutorial assignments, solutions, participants will also have the opportunity to work on practical MATLAB projects and will be given the relevant program code. More information regarding the course can be found at the website below

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

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

1. Principles of Wireless Communication
2. Fading Channels, Bit-Error Rate (BER) Analysis
3. Multiple Antenna Systems, Diversity Concept
4. Multiple-Input Multiple-Output (MIMO) Technology
5. Multi-user MIMO, Beamforming, Precoding
6. Orthogonal Space Time Block Codes (OSTBC)
7. Cooperative communication, Optimal combining
8. BER Analysis for Cooperative Communication
9. Optimal power allocation with Cooperation
10. Introduction to Massive MIMO
11. Massive MIMO Analysis with Perfect CSI
12. Channel Estimation in Massive MIMO, Imperfect CSI
13. Multi-cell Massive MIMO and Pilot contamination
14. New modulation schemes for 5G: Spatial Modulation
15. Space Shift Keying, Generalized Spatial Modulation
16. Cooperative MIMO, Multi-node Cooperation
17. AF and DF Protocols for Cooperation
18. Introduction to Cognitive Radio, OFDM for CR
19. Spectrum Sensing in Fading Channels
20. Spectrum Sensing for MIMO systems, OFDM systems
21. Cooperative Spectrum Sensing, Eigen Spectrum Sensing
22. Multi-user Transmission in CR Systems
23. MIMO for Underlay CR Systems
24. Game theory for Cognitive Radio, Spectrum Auctions
25. MATLAB Project on Fading Wireless Channels, Multiple-Antenna Systems, MIMO Systems and OFDM Systems
26. MATLAB Project on Massive MIMO Systems and Receiver Design with Perfect/ Imperfect CSI
27. MATLAB Project on Cooperative Communication, MIMO Cooperation, Multiple-Node Cooperation
28. MATLAB Project on Spectrum Sensing for Fading Channels, Spectrum sensing for MIMO-OFDM Systems

Please do not hesitate to contact us for any further information

Thanking you,

(Prof. Aditya K. Jagannatham)  
Professor, IIT Kanpur  
e-mail: [iitk5G.vizag@gmail.com](mailto:iitk5G.vizag@gmail.com)