Online MATLAB Project Course on Latest MIMO Technologies for 5G Networks and IoT: Massive MIMO, mmWave MIMO, NOMA, Cooperative Communication, Cognitive Radio and IoT

July 27th - August 3rd, 2020

Organized by Department of Electrical Engineering IIT Kanpur

Important Information for the short course at IIT Kanpur

Welcome to this short course at IIT Kanpur! We are delighted to have you as a participant. Please go through some essential information in this document. Please note that this course will be conducted online via zoom.

Contact Information

Note: Please contact only in case of **emergency**

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Important notes:

1. Only hard copy of lecture material will be provided. Due to IPR related concerns, soft copies will not be provided. This will be sent by post/ courier as and when normal services resume either before or after the course.
2. Recording of lectures, uploading/ distribution of video or audio lectures or course notes is NOT permitted.
3. Participants have to ensure connectivity for the duration of the course. Recorded video lectures will NOT be available. All participants should test their connections during the Zoom test sessions mentioned in Program.
4. We currently do not allow participants from countries other than India.

Tentative Schedule

The tentative schedule for the duration of the short course from July 27th to 3rd August, 2020 is available online at:

http://www.iitk.ac.in/mwn/latest5G/programme.html

Test Day 1: July 23rd, 2020	
12:00 PM – 12:30 PM	**Zoom Test Session 1**
Test Day 2: July 25th, 2020	
1:00 PM – 1:30 PM	**Zoom Test Session 2**
DAY 1: July 27th, 2020 (MONDAY)	
09:00 AM- 10:15 AM	5G Network Goals and Overview of Key Technologies
10:15 AM- 10:45 AM	Break
10:45 AM- 12:15 PM	Introduction to Multiple-antenna, MIMO, MU-MIMO Technologies and Performance Analysis
12:15 PM- 02:00 PM	Break
02:00 PM- 03:15 PM	Problem Solving – 5G Wireless Technologies, Basics of Signal Processing, Receiver Design
03:15 PM- 03:45 PM	Break
03:45 PM- 05:15 PM	Introduction to mmWave MIMO Technology, Hybrid Signal Processing Architectures, Analog/ Digital Beamforming
DAY 2: July 28th, 2020 (TUESDAY)	
09:00 AM- 10:15 AM	Behavior and Modeling of mmWave MIMO Channels, Properties and Estimation of mmWave MIMO Channels
10:15 AM- 10:45 AM	Break
10:45 AM- 12:15 PM	Hybrid Transceiver Design for mmWave MIMO Systems, Radio Frequency (RF) and Baseband (BB) co-design of Precoders/ Combiners
12:15 PM- 2:00 PM	Break
02:00 PM- 03:15 PM	Problem Solving - mmWave MIMO, Hybrid Signal Processing Architectures, Sparse Signal Processing
03:15 PM- 03:45 PM	Break
03:45 PM- 05:15 PM	Introduction to Massive MIMO Technology, Comparison with Conventional MIMO, DL and UL Processing for multiuser Massive MIMO

	DAY 3: July 29th, 2020 (WEDNESDAY)
09:00 AM- 10:15 AM	Channel Model for Massive MIMO, Receiver Design, Performance Analysis and Power Optimization
10:15 AM- 10:45 AM	Break
10:45 AM- 12:15 PM	CSI Estimation for Massive MIMO, Performance Analysis and Power Scaling with CSI Distortion, Pilot Contamination in Massive MIMO
12:15 PM- 2:00 PM	Break
02:00 PM- 03:15 PM	Problem Solving – MIMO Performance, Channel Estimation, Massive MIMO
03:15 PM- 03:45 PM	Break
03:45 PM- 05:15 PM	New Modulation Schemes for 5G massive MIMO - Spatial Modulation (SM), Space Shift Keying (SSK) and Generalized Spatial Modulation (GSM)
	DAY 4: July 30th, 2020 (THURSDAY)
09:00 AM- 10:15 AM	Introduction to Non-Orthogonal Multiple Access (NOMA) for IoT, Development of System model and Analysis
10:15 AM- 10:30 AM	Break
10:30 AM- 11:30 AM	Invited Expert Lecture by Dr. Kapil Bhattad, Principal Engineer, Qualcomm
11:30 AM- 02:00 PM	Break
02:00 PM- 03:15 PM	Problem Solving: NOMA Analysis,
03:15 PM- 03:45 PM	Break
03:45 PM- 05:15 PM	Fixed NOMA Wireless Systems, Performance Analysis for UL and DL (Contd) Ordered NOMA Protocol, System Model and Performance Analysis
	DAY 5: July 31st, 2020 (FRIDAY)
09:00 AM- 10:15 AM	Cooperative Communication, Optimal Combining, Diversity and BER Analysis, Optimal Power Allocation
10:15 AM- 10:30 AM	Break
10:30 AM- 11:30 AM	Distinguished Guest Lecture by Prof. Chandra Murthy, Professor, IISc Bangalore
11:30 AM- 11:45 AM	Break
02:00 PM- 03:15 PM	Problem Solving: Cooperative Communication
03:15 PM- 03:45 PM	Break
03:45 PM- 05:15 PM	Cooperative MIMO Communication Systems, Mutiple Node Cooperative Communication Systems
	DAY 6: August 1st, 2020 (SATURDAY)
09:00 AM- 10:15 AM	Introduction to Cognitive Radio, OFDM for Cognitive Radio, Spectrum Sensing in Fading Wireless Channels, Cooperative Spectrum Sensing

10:15 AM- 10:30 AM	Break
10:30 AM- 10:45 AM	Group Photo Session of Course Participants
10:45 AM- 12:15 PM	Multi-User Transmission for Interweave CR Systems, MIMO Precoding for Underlay CR Systems
12:15 PM- 2:00 PM	Break
02:00 PM- 03:15 PM	Problem Solving: Cognitive Radio Systems
03:15 PM- 03:45 PM	Break
03:45 PM- 05:15 PM	5G New Radio (NR) Standard, LTE- Cat M1 and Cat NB 1 Standards for Narrowband IoT
DAY 7: August 2nd, 2020 (SUNDAY)	
09:00 AM- 10:15 AM	MATLAB Project on mmWave MIMO Channel Modeling, Beamspace Channel Representation, Sparse Channel Estimation
10:15 AM- 10:45 AM	Break
10:45 AM- 12:15 PM	MATLAB Project on Hybrid Transceiver Design for mmWave MIMO, Optimal RF and Baseband Precoder/ Combiner Design
12:15 PM- 2:00 PM	Break
02:00 PM- 03:15 PM	MATLAB Project on Massive MIMO System Implementation with Perfect CSI, Channel Estimation, Performance for ZF and MF Receivers, Performance with Imperfect CSI and Power Scaling
03:15 PM- 03:45 PM	Break
03:45 PM- 05:15 PM	MATLAB Project on New Modulation Techniques for Massive MIMO – Spatial Modulation (SM), Space Shift Keying (SSK), Generalized Spatial Modulation (GSM)
DAY 8: August 3rd, 2020 (MONDAY)	
09:00 AM- 10:15 AM	MATLAB Project on Non-Orthogonal Multiple Access (NOMA) Systems, Fixed NOMA, Ordered NOMA, Outage Probability and Optimal Power Allocation How to prepare for competitive/ placement exams. Important concepts
10:15 AM- 10:30 AM	Break
10:45 AM- 12:15 AM	MATLAB Project on Cooperative Communication, MIMO Cooperation, Spectrum Sensing for Fading Channels
12:15 PM - 2:00 PM	Break
02:00 PM- 03:15 PM	Higher education opportunities available at IIT Kanpur and how to apply. Research areas and focus in IIT Kanpur in 5G and 6G Wireless Communication
03:15 PM- 03:45 PM	Break
03:45 PM- 05:15 PM	Frequently asked questions in Placement/ Ph.D./ M.Tech interviews and how to prepare