# Short Course in Bengaluru on Millimeter (mm) Wave MIMO and Filter Bank Multi-Carrier (FBMC) Technologies for 5G Networks with Capstone Project
## July 25<sup>th</sup>to 28<sup>th</sup>, 2018

**Organized by Prof. Aditya K. Jagannatham, EE Department, IIT Kanpur in association with E & C Dept., Ramaiah Institute of Technology, Bengaluru**

### IMPORTANT INFORMATION FOR THE SHORT COURSE AT MSRIT, Bangalore

Note:

1. Campus map of MSRIT are given at the end of the document.

2. **Please bring a scientific calculator along with you to participate in problem solving during lectures and tutorial sessions. If possible, please also bring laptop with MATLAB installed and fully charged during all regular course days also. In addition, capstone project participants are required to bring Laptop with MATLAB preferably R13 or later to participate in the capstone projects to be conducted on 28th July, 2018.**

## Contact Info

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

| | | |
|---|---|---|
| Narendra Singh | narend@iitk.ac.in | 9935290881, 9044635721 |
| Parul Srivastava | psrivast@iitk.ac.in | 7054568434 |

## How to reach MSRIT, Bangalore

Bangalore is connected by rail and road with the major cities in India. MSRIT campus is located in Mathikere area. MSRIT is located at a distance of about 7 kilometers from the KSR Railway Station (Majestic), 3 Kilometers from Yeswanthpur railway station and 8 kilometers from Cantonment railway station. **Taxis are available from the KSR Railway Station (Majestic) (from Platform number 1 side).** There is a pre-paid auto and taxi booth. **The rates are about Rs. 200/- to 250/- for a taxi and Rs. 50/- for an auto-rickshaw.** Sometimes you may be able to negotiate a few rupees less with the driver, if you don't go to the pre-paid booth. For taxi services you can also call the following taxi agencies.

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|---|---|
| Sunil Travels | 9739438108/ 9980934666 |

**Important Note:** Please note visitor can through gate 10.

**Please note that transportation has to be arranged by the participant and the associated charges have to be borne by the participant. These are not covered in the registration fees.**

## Air connectivity

Visitors coming over to Bangalore have to get down at Kempegowda Airport, Bangalore is capital of the state of Karnataka, India. One can avail the taxis at the airport taxi-stand, but they can ask for any arbitrary amount. You can use the taxi service numbers listed above to book a taxi in advance. **Depending on the type of vehicle, these taxis will charge between Rs 1200/- and Rs. 1600/-. (Charge for Air-conditioned taxi is only Rs. 100/- to 200/- extra.)**

### Accommodation Information

Accommodation for the participants is NOT provided, but assistance is provided. You can book the rooms, details is mention below.

Accommodation Details:

1. **Grand**
   Boys PG and Lodge, 1$^{st}$ Cross, Near Ramaiah Engg College bus stop, Mathikere, Bangalore – 54. Contact No. (080) 41101338, (+91) 9972381338. (Approx: Rs 650/- per 2 persons and Rs 800/- per 3 persons)

2. **Maurya Pardise Inn**
   #7/1, MSREC Road, Mathikere, (Near Ramaiah Engg College bus stop), Bangalore – 54. Ph: 080-41279589. (Approx: Rs 850/- per single, Rs 1000/- per 2 persons and Rs 1300/- per 3 persons)

3. **Royal Residency**
   #8/1, 2$^{nd}$ Cross, MSRIT College Road, Mathikere (Near Ramaiah Engg College bus stop), Bangalore – 54. Ph: 080 – 42086870, 09886537666. (Approx:  Rs 1000/- per 2 persons and Rs 1300/- per 3 persons)

4. **Visitors Comfort**
   #4, Sai Shamik Plaza, 3$^{rd}$ Cross, Opposite to M. S. Ramaiah College gate, Mathikere , Bangalore – 54. Ph: 080 – 40933635, 9743858076. (Approx: Rs 1100/- per 2 persons and Rs 1300/- per 3 persons).

 **Also note accommodation is NOT included in the registration fees.**

## Breakfast/ Meals Information

Participants have to bear food expenses. Participants can have breakfast, lunch and dinner in MSRIT Canteen. Timings are as follows.

Breakfast: 8:30 AM to 11:00 AM

Lunch: 12:30 PM to 2:00 PM

In addition there are a variety of food outlets in and around MSRIT. Their location, timing details with contact information are given below.

| Food outlet | Location/ Timing |
|---|---|
| Food Village | Near gate 10, MSRIT Campus, 11:00 am- 11;00 pm |
| Nandini Deluxe | New BEL Road, 11:00 am- 11;00 pm |

**The venue for the lecture part of the short course is in LHC Seminar Hall-II, MSRIT Campus**

Course folder, stationary and printed course material will be provided on 25th July morning during the registration session starting at 8:30 AM. Course certificate and receipt for the short course registration will be given only to those who attend all modules of the course and after all the payment dues are cleared.

Please bring a scientific calculator along with you to participate in problem solving during lectures and tutorial sessions.

# [Map Showing Route From Majestic Gate to MSRIT Campus]
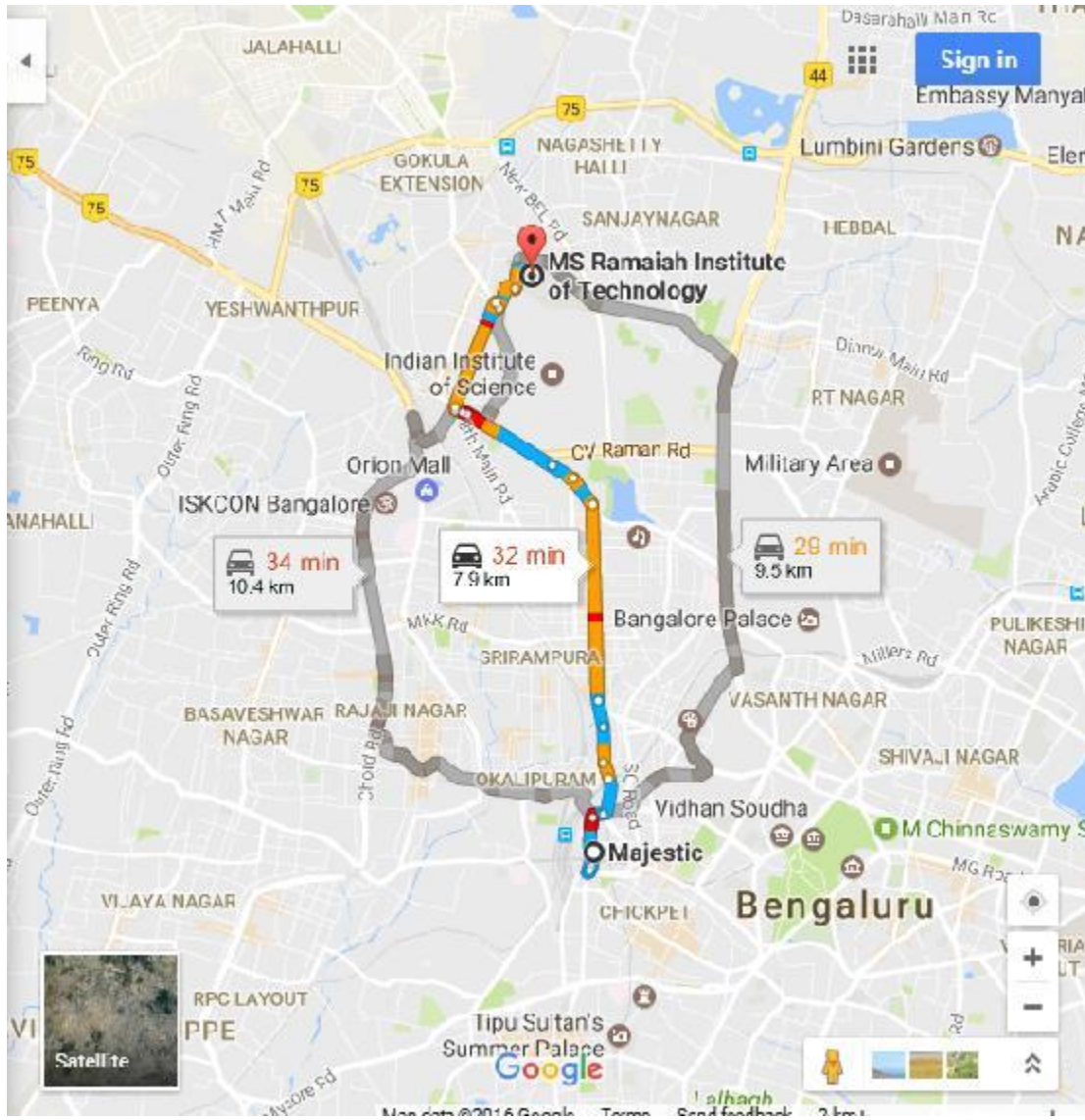
## Tentative Schedule

The tentative schedule for the duration of the short course from 25th to 28th July is available online at:

http://www.iitk.ac.in/mwn/mmwave/index.html

| Day 1: July 25th, 2018 (Wednesday) | |
| --- | --- |
| 08:30 AM | Registration |
| 09:00 AM- 10:15 AM | Overview of 5G Wireless Networks and New Technologies for 5G |
| 10:15 AM- 10:30 AM | Tea Break |
| 10:30 AM- 11:30 AM | Making 5G NR a reality – By Dr. Kapil Bhattad, Senior Staff Engineer, Qualcomm |
| 11:35 AM- 12:35 PM | Introduction to mmWave MIMO Wireless Technology and Architectures |
| 12:35 PM- 02:00 PM | Lunch Break |
| 02:00 PM- 03:15 PM | Tutorial on 5G and mmWave MIMO Technology |
| 03:15 PM- 03:45 PM | Tea Break |
| 03.45 PM- 05:15 PM | Signal Processing for sub 6GHz MIMO Technology and massive MIMO technology |
| Day 2: July 26th, 2018 (Thursday) | |
| 09:00 AM- 10:15 AM | MIMO Channel Models and Channel Estimation for mmWave MIMO |
| 10:15 AM- 10:45 AM | Tea Break |
| 10:45 AM- 12:15 PM | Hybrid Signal Processing and Analog/ Digital Beamforming for mmWave MIMO |
| 12:15 PM- 2:00 PM | Lunch Break |
| 02:00 PM- 03:15 PM | Tutorial on Signal Processing for mmWave MIMO |
| 03:15 PM- 03:45 PM | Tea Break |
| 03:45 PM- 05:15 PM | Precoder/ Combiner Design for mmWave MIMO Systems |
| Day 3: July 27th, 2018 (Friday) | |
| 09:00 AM- 10:15 AM | Introduction to Filter Bank Multicarrier (FBMC) Technology |
| 10:15 AM- 10:45 AM | Tea Break |
| 10:45 AM- 12:15 PM | FBMC Implementation, OQAM Modulation for FBMC and Analysis, Advantages over OFDM |
| 12:15 PM- 2:00 PM | Lunch Break |
| 02:00 PM- 03:15 PM | Tutorial on FBMC and OFDM Technologies |
| 03:15 PM- 03:45 PM | Tea Break |
| 03:45 PM- 05:15 PM | MIMO-FBMC Signal Processing and Architecture, Receiver techniques |
| Day 4: July 28th, 2018 (Saturday)-Only for Capstone Project Participants | |

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|---|---|
| 09:00 AM- 10:15 AM | Project in mmWave MIMO Channel Estimation, mmWave MIMO Channel Modeling |
| 10:15 AM- 10:45 AM | Tea Break |
| 10:45 AM- 12:15 PM | Project in mmWave MIMO Precoder/ Combiner Design, Hybrid Signal Processing |
| 12:15 PM- 2:00 PM | Lunch Break |
| 02:00 PM- 03:15 PM | Project on FBMC and OFDM Implementation, FBMC-OQAM Technique |
| 03:15 PM- 03:45 PM | Tea Break |
| 03:45 PM- 05:15 PM | Project on MIMO-FBMC Implementation, Receiver Design |