

## GIAN Sponsored Two Week STC on Next Generation MIMO and OFDM Wireless Technologies (8 December 2017 – 17 December 2017)

### Overview

Global mobile data traffic grew 69% between 2013 and 2014 and reached 2.5 Exabyte (EB) per month at the end of 2014. Global Internet traffic increased 2900% between 2000 and 2014. Almost 500 million mobile devices (439 million smartphones) and connections were added in 2014. By 2018, 10 billion mobile connections will generate more than 15 EB of traffic. The massive traffic growth is also driven by cloud computing, smart grid, health care, logistic, automation, multimedia games, Netflix and many others. Moreover, current human-to-human (H2H) connections will be complemented by Internet of Things (IoT) and Machine-to-Machine (M2M), which will introduce more than 50 billion online devices by 2020 that need wireless connections. The coexistence of H2H and M2M imposes additional and diverse requirement. These facts demand wireless standards be drastically improved way above 4G (fourth generation) LTE (long term evolution). Thus, 5G requires high throughput, low latency, and scalable support for billions of devices, as specified in Table 1.

Parameter	Gain
Data rate	10-100
Latency	1/10
Energy efficiency	100
Traffic	1000
Capacity	100

Two fundamental wireless Technologies are (i) multiple-input multiple-output (MIMO) wireless uses more than one antenna to focus a radio beam on a receiver, (ii) orthogonal frequency division multiplexing (OFDM).

In the last two decades, MIMO technology has been extensively researched to improve the robustness and performance of wireless links. This improvement is achieved by exploiting multipath

Table 1. 5G vs. 4G.

propagation with the use of advanced signal processing and communication algorithms.

OFDM has become a widely used digital multicarrier modulation method (e.g., the LTE downlink uses it). In OFDM, several orthogonal subcarriers are used to carry data, which is divided into several parallel data streams, each modulating one of the subcarriers. The key benefits of OFDM in this context are the low-complexity receiver and the ability to operate in different bandwidths according to spectrum availability.

### Objective

This course will help the participants to learn latest wireless technologies, which are driving the developments of next generation (e.g., 5G) wireless standards. The participants will gain access to latest theories as well as some hands-on simulation codes. By the end of the course, the participants will develop better understanding to not only access but also publish international IEEE journal and conference papers. This knowledge will help faculty members and similar participants to develop grant applications and research projects on wireless networks. For graduate students and junior researchers, this course will help to identify new research problems and publish papers. The primary objectives of the course are as follows:

- (i) Discuss in detail the fundamentals of MIMO and OFDM wireless technologies,
- (ii) Build the confidence and capability amongst the participants in the application of these technologies to develop wireless standards, networks, links and IP (intellectual property),
- (iii) Provide an introduction to practical wireless design problems and their solutions, through MATLAB simulations and codes,
- (iv) Enhance capability of the participants to identify and formulate research problems on 5G wireless networks.

Dates	8 <sup>th</sup> December to 17 <sup>nd</sup> December 2017	
Location	ECE Dept., National Institute of Technology (NIT) Kurukshetra, Haryana, India.	
<b>Course Schedule</b>	8 <sup>th</sup> December 2017 (Friday)	Lecture-1: Topic: Wireless channel models, propagation and fading. Lecture-2: Topic: Wireless channel models, propagation and fading Tutorial-1 Topic: Problem solving session using MATLAB.
	9 <sup>th</sup> December 2017 (Saturday)	Lecture-3: Topic: SISO and MIMO channels, spatial correlation, broadband models.  Lecture-4: Topic: SISO and MIMO channels, spatial correlation, broadband models. Tutorial-2: Topic: Problem solving session using MATLAB.
	10 <sup>th</sup> December 2017 (Sunday)	Lecture-5: Topic: Introduction to MIMO systems, channel capacity, SIMO, MISO, and SISO special cases.  Lecture-6: Topic: Introduction to MIMO systems, channel capacity, SIMO, MISO, and SISO special cases. Tutorial-3: Topic: Problem solving session using MATLAB.
	11 <sup>th</sup> December 2017 (Monday)	Lecture-7: Topic: Diversity and multiplexing for MIMO systems, space time codes.  Lecture-8: Topic: Diversity and multiplexing for MIMO systems, space time codes. Tutorial-4: Topic: Problem solving session using MATLAB.

	12 <sup>th</sup> December 2017 (Tuesday)	Lecture-9: Topic: MIMO signal detection algorithms including zero forcing, MMSE, sphere decoding.  Lecture-10: Topic: MIMO signal detection algorithms including zero forcing, MMSE, sphere decoding. Tutorial-5: Topic: Problem solving session using MATLAB.
	13 <sup>th</sup> December 2017 (Wednesday)	Lecture-11: Topic: Soft decision decoding methods, log-likelihood based decoding.  Lecture-12: Topic: Soft decision decoding methods, log-likelihood based decoding. Tutorial-6: Topic: Problem solving session using MATLAB.
	14 <sup>th</sup> December 2017 (Thursday)	Lecture-13: Topic: Introduction to OFDM, single carrier vs. multicarrier transmission, OFDM modulation and demodulation.  Lecture-14: Topic: Introduction to OFDM, single carrier vs. multicarrier transmission, OFDM modulation and demodulation. Tutorial-7: Topic: Problem solving session using MATLAB.
	15 <sup>th</sup> December 2017 (Friday)	Lecture-15: Topic: OFDM performance, power allocation, link adaptation, multiple access extensions of OFDM, resource allocation.  Lecture-16: Topic: OFDM performance, power allocation, link adaptation, multiple access extensions of OFDM, resource allocation. Tutorial-8: Topic: Problem solving session using MATLAB.
	16 <sup>th</sup> December 2017 (Saturday)	Lecture-17: Topic: PAPR reduction, distribution of OFDM signals, PAPR and oversampling, clipping and SQNR, clipping and filtering.  Lecture-18: Topic: PAPR reduction, distribution of OFDM signals, PAPR and oversampling, clipping and SQNR, clipping and filtering. Tutorial-9: Topic: Problem solving session using MATLAB.
	17 <sup>th</sup> December 2017 (Sunday)	Lecture-19: Topic: PAPR reduction codes, selective mapping, partial transmit sequence, tone reservation and tone rejection. Lecture-20: Topic: PAPR reduction codes, selective mapping, partial transmit sequence, tone reservation and tone rejection. Tutorial-10: Topic: Problem solving session using MATLAB.
<b>Who could attend?</b>	UG and PG Students, Research scholars, Faculty members, Practicing Engineers, and Scientists working in area related to wireless communication.	

## Course Fee

**One-Time GIAN Registration:** Please visit <http://www.gian.iitkgp.ac.in/GREGN/> and register by paying Rs. 500/- (those who have already been paid, need not pay again).

The participation fees for attending the course is as follows:

<b>Participants from abroad:</b>	US\$ 100
<b>Industry/ Research Organizations:</b>	Rs. 3000
<b>Academic Institutions (Faculty members/Researchers):</b>	Rs. 1000
<b>Students (Pursuing Bachelor's/Master's/Ph. D.):</b>	Rs. 500

- The course fee does not include boarding & lodging. However, the participants will be provided boarding & lodging facility on payment basis in the institute guest house/hostel.
- Participants are required to come with their laptops having Matlab installed on it.
- The registration fee has to be paid by DD drawn in favor of Director, NIT Kurukshetra, payable at SBI NIT Kurukshetra.

To register or for any questions please send an email to [arvind\\_sharma@nitkr.ac.in](mailto:arvind_sharma@nitkr.ac.in)

## Bank Details

**Account Name:** Director, NIT Kurukshetra. **Account No.:** 10116885013.

**Bank Name:** SBI. **Branch:** NIT Kurukshetra, Haryana, India.

**IFSC Code:** SBIN0006260.

**Last Date of Registration:** 25<sup>th</sup> November 2017.

## Registration Process

Registration for GIAN courses is not automatic because of the constraints on maximum number of participants allowed to register for a course. In order to register for one or multiple non-overlapping courses, you have to apply online using the following steps:

### Stage1:

Web (Portal) Registration: Visit GIAN Website at the link:

<http://www.gian.iitkgp.ac.in/GREGN/index> and create login user ID and Password. Fill up blank registration form and do web registration by paying Rs. 500/- on line through Net Banking/ Debit/ Credit Card. This provides the user with lifetime registration to enroll in any no. of GIAN courses offered.

### Stage2:

Course Registration (Through GIAN Portal): Log in to the GIAN portal with the user ID and Password created. Click on "Course Registration" option given at the top of the registration form. Select the Course titled "Next Generation MIMO and OFDM Wireless Technologies" from the list and click on "Save" option. Confirm your registration by Clicking on "Confirm Course".

Only Selected Candidates will be intimated through E-mail by Course Coordinators. They have to remit the necessary course fee in the form of DD drawn in favor of "Director, NIT Kurukshetra" payable at SBI NIT, Kurukshetra.

**The last date of registration is 25 November 2017.**

**Number of participants for the course is limited to 30.**

## International Expert



**Prof. Chintha Tellembura** is currently a professor at Department of Electrical & Computer Engineering, University of Alberta. He received B. Sc. Degree with first-class honors from the University of Moratuwa, Srilanka in 1985, M. Sc. from University of London, UK, in 1988, and Ph. D. in Electrical Engineering from the University of Victoria, Canada in 1993. He has been post-doctoral fellow at University of Victoria (1993-94) and University of Bradford (1995-96). He was with Monash University Melbourne, Australia from 1997- 2002. He served as an associate Editor (modulation and signal design) for IEEE Transactions on Communications and an area Editor for the IEEE Transactions on Wireless Communications. His research interests include Cognitive Radio, Heterogeneous cellular networks, Multi-carrier modulation (OFDM), and Multi-input multi-output (MIMO) wireless.

## Host Faculty:



**Arvind Kumar** is currently an Assistant Professor at Electronics & Communication Engineering Department, National Institute of Technology, Kurukshetra, Haryana, India. He completed his B. Sc. Degree from the Rohilkhand University, Bareilly, U.P., B. Tech. in Electronics & Telecommunication Engineering from J.K. Institute of Applied Physics & Technology, University of Allahabad, M. E. in Control & Instrumentation from MNNIT Allahabad, and Ph. D. in Electronics & Communication Engineering, NIT Kurukshetra. His research interests include wireless communication, OFDM & MIMO systems and optical communications.



**Prof. Rajoo Pandey** is currently a Professor at Electronics & Communication Engineering Department, National Institute of Technology, Kurukshetra, Haryana, India. He received his B.E., M. Tech., and Ph. D. Degrees in Electronics & Communication Engineering from GEC Jabalpur, NIT Kurukshetra, and IIT Roorkee, respectively. His research interests include signal and image processing, wireless communication, OFDM systems, and cognitive radio.

## Contact:

Course Coordinators		Local GIAN Coordinator
<p><b>Dr. Arvind Kumar</b> Assistant Professor Department of Electronics and Communication Engineering NIT Kurukshetra. Haryana, India. Tel: 91-9466368417. Email: <a href="mailto:arvind_sharma@nitkkr.ac.in">arvind_sharma@nitkkr.ac.in</a></p>	<p><b>Prof. Rajoo Pandey</b> Professor Department of Electronics and Communication Engineering NIT Kurukshetra. Haryana, India. Tel: +91-9416840435 Email: <a href="mailto:rajoo_pandey@nitkkr.ac.in">rajoo_pandey@nitkkr.ac.in</a></p>	<p><b>Prof. A. Swarup</b> Professor Department of Electrical Engineering NIT Kurukshetra. Haryana, India. Tel: +91-9416266610 Email: <a href="mailto:aswarup@nitkkr.ac.in">aswarup@nitkkr.ac.in</a></p>

GIAN Short Term Course on  
Next Generation MIMO and OFDM  
Wireless Technologies

December 8-17, 2017

**REGISTRATION FORM**

Name: \_\_\_\_\_

Designation: \_\_\_\_\_

Department: \_\_\_\_\_

Academic Degree: \_\_\_\_\_

Address for correspondence:

Phone: \_\_\_\_\_

E-mail: \_\_\_\_\_

Category of participant:

Faculty/Student/Research Scholar of NITKKR

Faculty/Student/Research Scholar of other  
Institute

Industry Participant

Foreign Participant

Accommodation required: Yes/No

Payment Details: \_\_\_\_\_

Amount \_\_\_\_\_

DD no. and date \_\_\_\_\_

Payment Mode: DD for registration fee is in favor of  
the Director, NIT Kurukshetra payable at Kurukshetra.

I agree to attend the course for the entire  
duration

Signature of applicant

Signature of sponsoring  
authority with Seal

**Lecture Notes**

To fully realize the objectives of the course, the course material will be made available during the time of course at NIT Kurukshetra.

**Course Fees**

The participation fees for taking the course is as follows:

Participants from abroad	:	US \$ 100/-
Industry/Research Organization	:	Rs. 3000/-
Faculty Members / Researches	:	Rs. 1000/-
Students(pursuing Bachelors / Masters courses/Ph. D.)	:	Rs. 500/-

The above fee includes all instructional materials and assignments, laboratory equipment usage charges.

**Payment Mode**

The registration fee has to be paid by DD drawn in favor of Director, NIT Kurukshetra, payable at SBI NIT Kurukshetra.

**Accommodation**

Subject to availability, the participants may be provided accommodation (boarding & lodging) at the Institute Guest Houses/ hostels on payment basis. Please send request for accommodation in advance.

**Address for all Correspondence**

**Dr. Arvind Kumar & Prof. Rajoo Pandey**

Course

Coordinators

Department of ECE,

National Institute of Technology

Kurukshetra, Kurukshetra-136119,

Haryana, India.

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