Signal Processing, Communication & Networks *IIT Kanpur*

Simulation-Based Design of 5G Wireless Standards **3-0-0-0-9**

Course Objectives and teaching methodology:

Students normally have good theoretical background in wireless communications systems, but negligible exposure on the use of this theory to design practical wireless systems. Many jobs in the wireless communication industry require design of standards-based practical wireless systems. A main objective of this course is to bridge the gap between the theory and practice of 5G NR wireless communication systems, and consequently the gap between the academia and the industry.

To achieve the objective, this course will teach: i) underlying concepts of 5G NR transceiver blocks; and ii) how to read the 5G NR standard documents to understand the transceiver specifications. Students will then design and simulate a 5G NR-compliant wireless system in MATLAB. The course therefore involves MATLAB coding component, which will also be considered for evaluation.

Pre-requisites: None

Course Contents:

- **5G-NR transmission structure**
  - Use cases – eMBB (enhanced Mobile Broadband), mMTC (massive Machine Type Communications) and URLLC (Ultra Reliable Low-Latency Communications)
  - 5G Spectrum,
  - Principles of adaptive modulation and coding,
  - ARQ and HARQ protocols, frame structure
- **5G-NR Transport-Channel Processing**
  - Notion of transport block (TB),
  - CRC generation for TB, code block segmentation,
  - LDPC coding ideas, rate matching,
  - Scrambling, modulation, baseband pass band representation, Resource Mapping
- **Reference Signal Design 5G-NR Initial Access**
  - Cell-specific reference signal,
  - Demodulation reference signal,
  - Concept of synchronization signals and broadcast channels

Instructor: Rohit Budhiraja (rohitbr@iitk.ac.in)

TAs: TBD
Class Room : Online
Slot/Time: Sat 09:00 - 10:00 hrs.

Exams and Project:

MATLAB assignments - 30%
Mid-term exam– 20%
Final exam – 30%
Attendance – 20%

Books:

- **5G NR: The Next Generation Wireless Access Technology**
  Erik Dahlman, Stefan Parkvall, and Johan Sköld
  Elsevier 2018

Rohit Budhiraja