Course Type	CourseCode	Nameof the Course	L	T	P	Credits
DE	NECD530	**Mobile Communication**	3	0	0	3

CourseObjective

- To inculcate students about the basics of designing the transceivers for mobile communication systems to achieve reliable communication over wireless channel.
- To create the ability among the students for developing mathematical model ofthe practical impairments of a mobile communication system.
- To make the students able to design electronic circuits for mobile communication systems to mitigate the practical impairments.
- To motivate students to propose novel techniques in both base-band and RF domain to obtain robust transceiver for the next generation of communication systems.

LearningOutcomes

On successful completion of this course, students will be able to

- Get the basics of how channel parameters are affecting the design of RF communication systems.
- Design theoretical signal processing algorithms and practical circuits for transceivers of communication systems.
- Develop theoretical algorithms to mitigate the impairments arising at the transmitter and receiver.

Unit No.	Topicsto beCovered	Lecture Hours	LearningOutcome
1	Introduction to the communication system models: Salient features of 2G, 3G 4G and 5G Cellular networks. Large scale path loss models, small scale fading, Discrete-time base-band transmission model, base-band to Pass-band conversion, noise figure, receiver sensitivity.	10	Students will learn the basics of wireless channel, RF communication mechanism
2	Basics of existing 4G/5G wireless technologies: Basics of OFDM modulation scheme, Time diversity, frequency diversity, antenna diversity, Introduction to MIMO signal transmission and reception, Introduction to massive MIMO.	10	Students will get knowledge to design transceivers for the existing 4G/5G technologies by assuming the absence of practical impairments.
3	Modeling of impairments in communication systems: analog front-end, up/down conversion architectures, oscillator phase noise, sampling jitter, IQ imbalance, carrier frequency offset (CFO), sampling frequency offset (SFO), error vector magnitude (EVM), DAC/ADC interface, quantization noise and clipping, dynamic range, ADC noise floor, non-linearities: 1 dB compression point, power amplifier (PA) non-linearities, AM/AM, AM/PM.	11	Students will learn to model the impairments which arise during the design of transceivers for a practical communication systems.
4	Compensation techniques: Tx/Rx IQ imbalance estimation and compensation, Synchronizations for OFDM, Effect of CFO in OFDM, CFO estimation and compensation in OFDM, effect of timing offset in OFDM, timing offset estimation in OFDM, SFO estimation and correction in OFDM.	11	Students will learn the methods to compensate the impairments, which is required to develop a robust transceiver for communication systems.

Text Books:

1) Goldsmith, Andrea. Wireless communications. Cambridge university press, 2005.
2) Marzetta, Thomas L. Fundamentals of massive MIMO. Cambridge University Press, 2016.
3) Lydi Smaini, RF Analog Impairments Modeling for Communication Systems Simulation: Application to OFDM-based Transceivers, John-Wiley & Sons, 2012.

Reference Books:

1. Tony J. Rouphael, Wireless Receiver Architectures and Design: Antenna, RF, Synthesizers, Mixed Signal and Digital Signal Processing, Academic Press, 2014.

2. Abbas Mohammadi and Fadhel M. Ghannouchi, RF Transceiver Design for MIMO Wireless Communications, Springer-Verlag, 2012.
3. Rappaport, Theodore S. Wireless communications: principles and practice. Vol. 2. New Jersey: prentice hall PTR, 1996.
4. Tse, David, and Pramod Viswanath. Fundamentals of wireless communication. Cambridge university press, 2005.