Course Type	Course Code	Name of the Course	L	T	P	Credits
DC	NECC501	Emerging Communication Systems	3	1	0	4

Course Objective

- To make students uunderstand the various blocks of modern communication system.
- To introduce the 4G/4G-LTE communication.

Learning Outcomes

On completion of this subject, students will have developed the following skills:

- Ability to apply knowledge of basic science and engineering fundamentals in modern communication;
- Ability to undertake problem identification, and formulation of practical solutions;
- Capacity for independent critical thinking, rational inquiry and self-directed learning.

Further, the knowledge will be very much helpful for the students to do the research work in academia and various industries like Qualcomm, Samsung and Intel etc.

Prerequisite

Knowledge of Digital Communication at UG level.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Introduction of wireless and mobile radio communication system. Cellular concept system design fundamentals. Mobile Radio Propagation- Large-Scale Path Loss, Free Space Propagation Model, Small Scale Fading and Multipath. Parameters of Mobile Multipath Channels.	7L+2T	Students will learn the fundamentals of cellular communication.
2	Geometric representation of signals, Gram-Schmidt Orthogonalization. Advanced Digital Modulation Techniques - QPSK, Offset QPSK, $\pi/4$ QPSK, BFSK, MSK, GMSK. Power and bandwidth efficiency of different schemes. Non-coherent Orthogonal Modulation techniques.	6L+2T	Students will learn the modulation techniques being used in modern communication system.
3	Receivers for non-ideal channel – signal distortion over a communication, equalization techniques, Linear Equalizers. Algorithms for adaptive equalization Diversity techniques over a fading channel. RAKE Receiver. Receiver design challenges	7L+2T	Students will learn about the receiver system design and analysis.
4	Spread Spectrum Modulation – DSSS and FHSS systems, CDMA of DSSS, applications of spread spectrum systems. Multicarrier communication. Basic MIMO model, MIMO capacity in fading channels, Diversity multiplexing trade off, Space-time code for MIMO wireless communication. Software Define Radio (SDR).	8L+3T	Students will learn modern technologies of MIMO and spread spectrum.
5	4G system- Introduction, Network Architecture and protocol. Long Term Evaluation (LTE). Downlink access: OFDM, Effect of frequency selectivity on OFDM Performance. Single carrier FDMA. Frequency diversity. Random access.	8L+3T	Students will learn basics of 4G system.
6	Introduction of 5G, LTE advanced and VoLTE. Uplink and downlink control signalling. LTE performance of 5G Networks.	6L+2T	Students will be introduced to the advanced LTE and VoLTE system for 5G.
		42L+14T	

Text Books:

1. Wireless Communications, Principles, Practice by Theodore, S. Rappaport, 2nd Ed., 2010, PHI.
2. An Introduction to LTE: LTE, LTE-Advanced, SAE, VoLTE and 4G Mobile Communications by Christopher Cox, 2nd ed., 2014, Wiley.

Reference Books:

3. Modern Wireless Communication by S. Haykin and M. Moher, 2011, Pearson Education.
4. Fundamentals of Wireless Communication by Tse, David, and Pramod Viswanath, 2005, Cambridge University press.
5. MIMO Wireless Communications by C. Oestges and B. Clerckx, 1st Ed, 2007, Elsevier.
6. LTE for 4G Mobile Broadband Air Interface Technologies and Performance by Farooq Khan, 2009, Cambridge Univ. Press.