The LNMIIT, Jaipur
Electronics and Communication Department
Principles of Wireless Communication
(ECE-3XXX)

Programme: B. Tech. (ECE)	Course Title: Principles of Wireless Communication		Course Code: ECE 3XXX
Type of Course: Program Elective	Prerequisites: Digital Communication		Total Contact Hours: 40
Year/Semester: 3rd /Even	Lecture Hrs/Week: 3	Tutorial Hrs/Week: 0	Practical Hrs/Week: 0	Credits: 3

Learning Objective:

The objective of the course is to introduce students about the fundamental wireless communication concepts such as frequency reuse and handoff, coverage and capacity tradeoff, trunking theory, interference issues. It presents different ways of modeling radio propagation mechanism and estimate the large-scale, small scale effects including fading, time delay spread and Doppler spread of radio signal in various operating scenarios. It describes how to measures and model the impact that signal bandwidth and motion have on the instantaneous received signal through the multi-path channel. It provides idea about modulation and multiple access techniques used in existing and emerging wireless standards.

Course outcomes (COs):

On completion of this course, the students will have the ability to:		Bloom's Level
CO-1	**Understand** functions, operational principles of wireless communication, frequency planning, capacity improvement and **analyze** call blocking, call delay probability	**2,4**
CO-2	**Understand** the complicated nature of wireless propagation and be able to **apply** different models to calculate link budget, path loss, **Derive** outage probability	**2,3,5**
CO-3	**Optimize** a cellular system for a service area considering traffic, mobility, path loss, coverage, capacity, QoS, Fading, shadowing etc.	**4**
CO-4	**Derive** expression for system under various scenarios like diversity reception, fading, BER performance and understanding of multiple access / communication techniques such as spread spectrum, TDMA,FDMA,CDMA,SDMA	**5**
CO-5	**Understand** and **compare** different modulation schemes, advance OFDM based systems like MIMO-OFDM, used in wireless communications.	**2,5**
CO-6	**Understand** and **classify** between the existing and emerging Wireless system standards.	**2**

Topics	Lecture Hours	
UNIT - I **1.** **FUNDAMENTALS OF WIRELESS COMMUNICATIONS**	**9**	9
1.1 Introduction to Wireless Communication, Challenges in Wireless Communication.	1	1
1.2 Wireless standards and data rates, features, and overview	1	1
1.3 Frequency Planning, Clustering Co-channel interference, Adjacent channel interference Sectoring cell splitting.	2	2
1.4 Capacity of Wireless Channel, capacity improvement techniques	1	1
1.5 Introduction to Tele-traffic Theory channel, Queuing models, M/M/1, M/M/C/C, Derivation of Erlang B and Erlang C	2	2
UNIT - II **2.** **WIRELESS PROPAGATION**	**8**	8
2.1 Introduction of Wireless Propagation Models, Two Ray Ground Reflection	1	1
2.2 Empirical Models, Log Normal Shadowing, Okumura-Hata, Cost 251, Indoor Models	2	2
2.3 Link Budget analysis	1	1
2.4 Outage/ coverage Probability Calculation	1	1
2.5 Multipath fading and Inter Symbol Interference Doppler spectrum, and Jakes Model	2	2
2.6 Wireless Channel and Delay Spread Coherence Bandwidth and Coherence time of the Wireless Channel, Doppler Spread	1	1
UNIT - III **3.** **Diversity Multiple Access and Spread Spectrum**	**7**	7
3.1 Review of Modulation and Demodulation Techniques	1	1
3.2 Performance of Modulation Techniques over Wireless Channel	1	1
3.3 Introduction to diversity, EG, SC, MRC	2	2
3.4 BER of BPSK with Diversity, Spatial Diversity, Diversity order	1	1
3.5 Spread Spectrum: FHSS and DSSS	1	1
3.6 Multiple access: FDMA, TDMA, CDMA and SDMA schemes;	1	1
UNIT - IV **4.** **MIMO–OFDM**	**8**	8
4.1 Introduction to MIMO, MIMO System Model	1	1
4.2 MIMO MMSE Receiver, Zero-Forcing Equalizer	1	1

4.3 Capacity of MIMO System and Beam Forming	1	1
4.4 Introduction to OFDM and Multi-Carrier Modulation, OFDM Schematic	2	2
4.5 Cyclic Prefix and OFDM Based Parallelization and OFDM Example, Introduction to MIMO OFDM	2	2
4.6 Carrier Frequency offset and PAPR in OFDM	1	1
UNIT - V **5. Wireless Standards**	**8**	8
5.1 Cellular Mobile Communication standards: GSM (2G), UMTS 3G, LTE	1	8
5.1.1 GSM system architecture, GSM RAN	1	
5.1.2 **LTE** and **LTE-A** overview, LTE Network architecture	2	
5.2 Wireless LAN Standards IEEE 802.11 -WiFi	1	
5.3 Wireless MAN Broadband Standards IEEE 802.16 based WiMax	1	
5.4 Wireless PAN IEEE 802.15 Bluetooth	1	

Textbook/References:

Text Books:

1. Andrea Gold Smith, "Wireless communications", Cambridge University Press, 2005
2. Rappaport. T.S., "Wireless communications", Pearson Education, 2003
3. Randy L. Haupt, "Wireless Communications Systems: An Introduction", Willey, 2019
4. David Tse, Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge 2005.

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References:
1. Aditya K. Jagannatham, "Principles of Modern Wireless Communication", McGraw Hill 2016.
2. Simon Haykin & Michael Moher, "Modern Wireless Communications", Pearson Education, 2007
3. Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 2006.

Additional Resources:
1. *https://nptel.ac.in/courses/117/102/117102062/http://nptel.ac.in/video.php?subjectId=117103063*
2. *https://nptel.ac.in/courses/117/104/117104099/*

Evaluation Method	
Item	**Weightage (%)**
Quizzes	20
Midterm	30
Assignment	10
Final Examination	40

*Please note, as per the existing institute's attendance policy the student should have a minimum of 75% attendance. Students who fail to attend a minimum of 75% lectures will be debarred from the End Term/Final/Comprehensive examination.

CO and PO Correlation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	0	3	0	1	0	0	0	0	0	2	3	2	0
CO2	0	3	0	0	3	2	0	0	2	2	0	0	3	3	0
CO3	0	0	3	2	0	0	0	0	2	1	0	0	2	2	0
CO4	0	0	3	3	0	0	2	2	2	1	0	0	3	3	2
CO5	1	0	0	0	3	2	2	0	0	0	2	3	3	3	0
CO6	3	2	0	3	0	1	0	0	0	0	0	2	3	3	0

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Approved By: