COURSE MODULE FOR THE AY- 2025-26 (ODD Sem)

Course Syllabi with CO's

Department: **Electronics and Communication Engineering**

Course Code	Course Title	Core/Elective	Prerequisite	Contact Hours			Total Hrs/ Sessions
				L	T	P	
BEC703	Wireless Communication Systems	**Professional Core Course**	Fundamentals of Signals and System Principles of Communication System	**4**	**-**	**-**	**0**

Objectives

Course objectives:

1. Understand the concepts of signal propagation over wireless channels.
2. Understand the multiple access techniques used in cellular communications standards.
3. Understand the system architecture and layers of LTE based on the use of OFDMA and SC-FDMA principles.
4. Understand the design and coding of MIMO wireless systems.

Topics to be Covered as per the VTU Syllabus

MODULE-1

Principles of Wireless Communications: The Wireless Communication Environment, Modelling of wireless systems, System model for narrowband Signals, Rayleigh fading Wireless Channel.

The Wireless Channel: Basics of Wireless Channel Modelling, Average Delay Spread in Outdoor Cellular Channels, Coherence bandwidth, Relation between ISI and Coherence Bandwidth, Doppler fading, Doppler Impact on a wireless Channel, Coherence Time.

RBTL: L1, L2 ,L3

MODULE-2

Code Division for Multiple Access (CDMA): Basic CDMA Mechanism, Fundamentals of CDMA codes, Spreading Codes based on PN sequences, Correlation Properties of Random CDMA Spreading Sequences, Advantages of CDMA.

Orthogonal Frequency Division Multiplexing (OFDM): Introduction, Motivation and Multicarrier basics, OFDM basics, OFDM Example, MIMO OFDM, OFDM Peak to Average Power ratio, SC-FDMA.

RBTL: L1, L2 ,L3

MODULE-3

Evolution of Cellular Technologies: First Generation Cellular Systems, 2G Digital cellular systems – GSM and its Evolution, 3G Broadband Wireless Systems, Key Enabling Technologies and features of LTE, LTE Network Architecture.

Frequency Domain Multiple Accesses: Multiple Access for OFDM Systems, Orthogonal Frequency Division Multiple Access, Single Carrier Frequency Division Multiple Access.

RBTL: L1, L2 ,L3

MODULE-4

Multiple Input Multiple Output Wireless Communications: Introduction to MIMO Communications, MIMO system Model, MIMO Zero Forcing Receiver, MIMO MMSE Receiver, Singular Value decomposition of MIMO Channel, SVD and MIMO capacity, Alamouti and Space-Time Codes, Nonlinear MIMO receiver: V-Blast, MIMO Beamforming.

RBTL: L1, L2 ,L3

MODULE-5

Overview and Channel Structure of LTE: Radio Interface Architecture, LTE Design principles, Network Architecture, Radio Interface Protocols, Hierarchical Structure of LTE: Logical Channels, transport Channels and Physical Channels, Channel mapping, Downlink OFDMA Radio resources, Physical Resource Blocks for OFDMA, Uplink SC-FDMA Radio resources.

RBTL: L1, L2 ,L3

List of Text Books

1. Aditya K. Jagannatham, *Principles of Modern Wireless Communication Systems: Theory and Practice*, McGraw Hill Education (India) Private Limited, 2017. ISBN: 978-81-265-4231-4.
2. Arunabha Ghosh, Jun Zhang, Jeffrey G. Andrews, Rias Muhamed, *Fundamentals of LTE*, Pearson India Education Services Private Limited, 2018. ISBN: 978-93-530-6239-2.

List of Reference Books

1. T. L. Singal, *Wireless Communications*, McGraw Hill Education (India) Private Limited, 2016. ISBN: 978-0-07-068178-1.
2. Theodore Rappaport, *Wireless Communications: Principles and Practice*, 2nd Edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002. ISBN: 0-13-042232-0.
3. Gary Mullet, *Introduction to Wireless Telecommunications Systems and Networks*, First Edition, Cengage Learning India Pvt. Ltd., 2006. ISBN-13: 978-81-315-0559-5.

List of URLs, Text Books, Notes, Multimedia Content, etc

Advanced 3G and 4G wireless Mobile Communications: https://nptel.ac.in/courses/117104099

Course Outcomes	At the end of the course the student will be able to: 1. Describe the wireless channel models for slow and fast fading environments. 2. Explain the different multiple access technologies used in wireless communications. 3. Explain the system architecture and the functional standards specified in LTE 4G. 4. Describe the MIMO transmitter and receiver process using coding examples.

Internal Assessment Marks: Assessment Details of Semester End Exam (SEE) :

1. The SEE will be conducted for 100 marks with a question paper containing 10 full questions, each of 20 marks.
2. Each full question can have a maximum of 3 sub-questions.
3. There will be 2 full questions from each module covering all the topics of the module.
4. Students will have to answer 5 full questions, selecting one full question from each module.
5. The total marks will be proportionally reduced to 50.

Assessment Details of Continuous Internal Evaluation (CIE)

1. Three IA tests of 40 marks each will be conducted, the best two scores considered, and the marks scaled down to 25.
2. One assignments for 10 Marks
3. Quizzes and marks will be scaled down to 5
4. Virtual based activity for 10 marks
5. The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

The Correlation of Course Outcomes (CO's) and Program Outcomes (PO's)

Course Code:	BEC703	Course Title: Wireless Communication Systems												
List of Course Outcomes	Program Outcomes												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	3	2	-	2	-	-	-	-	-	-	2	3	-
CO-2	3	3	2	-	2	-	-	-	-	-	-	2	3	-
CO-3	3	3	1	-	2	-	-	-	-	-	-	2	3	-
CO-4	3	3	2	-	2	-	-	-	-	-	-	2	3	-

Note: 3 = Strong Contribution 2= Average Contribution 1 = Weak Contribution -= No Contribution