INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

DIGITAL SIGNAL PROCESSING FOR WIRELESS COMMUNICATION								
VI Semester: ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AECD41	**Elective**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Signals and Systems, Basic Electronics and Communication Systems								

I. COURSE OVERVIEW:

The aim of this course provides an in-depth understanding of digital signal processing techniques as applied to wireless communication systems. Students will learn the theoretical principles of digital signal processing in the context of wireless communication. The course will cover topics such as modulation, demodulation, coding, equalization, synchronization, and multiple access techniques; all tailored for wireless communication scenarios.

II. COURSES OBJECTIVES:

The students will try to learn

I. Digital modulation and demodulation techniques, including various modulation schemes such as QPSK, FSK, and QAM.
II. Explore error detection and correction techniques, and study equalization methods to mitigate channel distortion effects.
III. Understand the role of DSP techniques in wireless networking protocols such as Wi-Fi, LTE, and 5G.
IV. Understanding of wireless communication systems, including modulation techniques, multiple access schemes, channel coding, and wireless network protocols.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1	Demonstrate a deep understanding of wireless communication systems.
CO2	Analyze and implement digital signal processing algorithms.
CO3	Apply spectral analysis and frequency domain techniques to characterize wireless signals and understand bandwidth efficiency,
CO4	Design and implement error detection and correction algorithms specific to wireless communication
CO5	Design and implement digital filters for tasks such as noise filtering and channel equalization, and apply various modulation schemes.
CO6	Apply theoretical knowledge to real-world scenarios through simulation tools and software, demonstrating the ability to model wireless communication systems.

IV. COURSE CONTENT:

MODULE - I: INTRODUCTION TO WIRELESS COMMUNICATION SYSTEMS (10)
Overview of wireless communication fundamentals, wireless channel characteristics, modulation techniques, multiple access schemes, and digital communication principles. Challenges and constraints of wireless channels.

MODULE –II: DIGITAL SIGNAL PROCESSING FUNDAMENTALS (09)
Basics of digital signal processing, Discrete-time signals and systems, Fourier analysis, Z-transform, and digital filter design. Introduction to algorithms for signal processing and analysis.

MODULE –III: DIGITAL SIGNAL PROCESSING TECHNIQUES FOR WIRELESS CHANNELS (10):
Application of digital signal processing techniques to address challenges in wireless channels. Channel equalization, adaptive modulation and coding, interference mitigation, synchronization, and diversity techniques.

Hands-on exercises on implementing algorithms for improving signal quality and reliability in wireless channels.

MODULE –IV: ERROR DETECTION AND CORRECTION IN WIRELESS COMMUNICATION (10)
Error detection and correction techniques specific to wireless communication systems. Coverage of error- correcting codes , Reed-Solomon codes, convolution codes, and turbo codes. Interleaving and error detection methods to enhance data integrity over noisy wireless channels.

MODULE –V: DIGITAL SIGNAL PROCESSING FOR WIRELESS COMMUNICATION (09)
software-defined radio (SDR), cognitive radio, multiple antenna systems (MIMO), beam forming, and advanced modulation schemes. Channel prediction, modulation recognition, and intelligent signal processing, UWB and millimeter-wave communication systems offer high data rates and short-range communication, encryption, secure key exchange, and secure communication protocols.

V. TEXT BOOKS:

1. "Digital Signal Processing: Principles, Algorithms, and Applications" by John G. Proakis and Dimitris G. Manolakis
2. "Wireless Communications: Principles and Practice" by Theodore S. Rappaport:

VI. REFERENCE BOOKS:

1. **“**Digital Signal Processing: Principles, Algorithms, and Applications" by John G. Proakis and Dimitris G. Manolakis.
2. "Wireless Communication Systems: Advanced Techniques for Signal Reception" by K.V.S. Hari and A.G. Constantinides
3. "Wireless Communications: Principles and Practice" by Theodore S. Rappaport
4. "Digital Signal Processing: A Computer-Based Approach" by Sanjit K. Mitra

VII. ELECTRONICS RESOURCES:

1. NPTEL :: Fundamentals of Digital Signal Processing
2. NPTEL :: Digital Modulation Techniques
3. NPTEL :: Channel Coding and Error Control, Wireless Communication Fundamentals
4. https://nptel.ac.in/domains/discipline/112?course=112_1
5. https://onlinecourses.nptel.ac.in/noc22_ee99/preview

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Tech-talk topics
5. Assignments
6. Model question paper - I
7. Model question paper - II
8. Lecture notes
9. Early learning readiness videos (ELRV)

10. Power point presentations