INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

SIGNAL PROCESSING FOR COMMUNICATION AND BIOMEDICAL APPLICATIONS								
VI Semester: ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AECD38	**Elective**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Signals and systems								

I. COURSE OVERVIEW:

In communications engineering and signal analysis methodology, the comprehensive treatment of advanced communication systems from theoretical and practical approaches. For original knowledge dissemination and communication of tangible research outcomes in the field of Biomedical Signal Processing. Signal processing theories for biomedical applications based on time-domain approaches, spectral domain approaches, joint time and frequency methods, signal decomposition methods, sparse signal representations. Signal modalities based on ECG, EEG, EMG, PPG, voice, bioacoustics, and other biomedical signals of electrical, mechanical or chemical in nature. The role of software systems, hardware-software co-design and user-centered design factors for biomedical signal processing.

II. COURSES OBJECTIVES:

The students will try to learn

I. The basic signal processing techniques in analyzing biological signals.
II. The mathematical, scientific & computational skills related to the field of biomedical signal processing
III. The awareness of the complexity of biological signal and the impact, promise of biomedical engineering in understanding these signals.

III. COURSE OUTCOMES:

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

CO1	Interpret the biomedical signals, such as ECG and EEG and their acquisition and processing using advanced signal processing methods for improved healthcare diagnostics.
CO2	Understand the knowledge and skills necessary for statistical signal processing
CO3	Analyze the bio-signals like ECG,EEG , HRV signal for detecting diseases and health monitoring and model them using various linear models like AR model, MA model, ARMA model using MATLAB.
CO4	Summarize the techniques to analyze non- stationary signal in the time, frequency, time frequency domain methods, wavelets, ANN, Fuzzy logic and algorithm for Arrhythmia classification.
CO5	Understand the non-linear analysis of bio signals for heart rate variability and blood pressure variability using measures based on chaotic theory.
CO6	Understand the different biomedical signals, modeling and processing techniques using advanced signal processing for diagnosing the different diseases and improving healthcare

IV. COURSE CONTENT:

MODULE-I: INTRODUCTION TO BIO SIGNALS (10)
Introduction to bio signals- generation of bio signals-action potential, resting membrane potential, ECG-data acquisition, lead system, arrhythmias; EEG signals and characteristics, evoked potential, Computerized data acquisition system - basic requirements, Preprocessing of bio-signals removal of interferences due to power line & Electro Surgical Unit, Adaptive filtering fetal heart rate monitoring -a case study.

MODULE- II: STATISTICAL SIGNAL PROCESSING (10)
Statistical Signal Processing - Introduction to random signals and its characteristics, properties of random signals, moments of signal, Concepts of PDF, autocorrelation, cross correlation, covariance, estimation of power spectral density-parametric& non-parametric, Wiener filter, implementation of algorithm for autocorrelation and PSD using MATLAB.

MODULE-III: ANALYSIS OF BIO SIGNALS (10)
Analysis of bio signals, ECG- continuous monitoring, arrhythmia detection- algorithms and methods, HRV signal. EEG- video EEG, analysis of epilepsy using EEG, prediction.

Modeling of bio signals linear models- AR model, MA model and ARMA model, Modeling of ECG signal using MATLAB.

MODULE-IV: NON STATIONARY SIGNAL ANALYSIS (10)
Non stationary signal analysis: Time domain methods, frequency domain methods, time frequency methods, wavelets Classification - introduction to ANN and Fuzzy logic, algorithm for Arrhythmia classification.

MODULE-V: INTRODUCTION TO NONLINEAR ANALYSIS (08)
Introduction to nonlinear analysis of bio signals-chaos, Analysis of heart rate variability and blood pressure variability using measures based on chaotic theory.

V. TEXTBOOKS:

1. Peyton Z. Peebles "Probability, Random Variables & Random Signal Principles", TMH, 4th edition, 2009.
2. D. C. Reddy "Biomedical Signal Processing- Principles and Techniques", TMH, 2005.
3. Weitkunat R, "Digital Bio signal Processing" Elsevier, 1991.

VI. REFERENCE BOOKS:

1. 1 Varun Bajaj, G. R. Sinha, Chinmay Chakraborty, "Biomedical Signal Processing for Healthcare Applications ", CRC Press, 2021.
2. Cohen. A, "Biomedical Signal Processing" Vol. I Time & Frequency Analysis, CRC Press, 1986.

VII. ELECTRONICS RESOURCES:

1. NPTEL :: Electrical Engineering - NOC: Biomedical signal processing
2. NPTEL :: Electrical Engineering - NOC: Principles of signals and systems
3. https://onlinecourses.nptel.ac.in/noc21_bt50/
4. https://onlinecourses.nptel.ac.in/noc21_bt30/

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