16BM305 BIOMEDICAL SIGNAL PROCESSING

Hours Per Week :

L	T	P	C
3	1	2	5

Total Hours :

L	T	P
45	15	30

WA/RA	SSH/HSH	CS	SA	S	BS
20	48	6	12	3	2

Course Description and Objectives:

This course aims at the relationships among different theoretical measures of biomedical signals and an understanding of the information carried by them. The objective of this course is to study and analyze EEG, ECG, EOG and their transformations need for a specific application.

Course Outcomes:

The student will be able to :

- select a class of signal model.
- selecting a specific form of the model.
- process the biomedical signals.

SKILLS:

- ✓ *Apply signal processing techniques in bio signal analysis.*
- ✓ *Convert and process bio signals.*
- ✓ *Simulate an characterize the various bio signals measured in the body.*
- ✓ *Design signal processing techniques for application specific biomedical equipment.*

UNIT - 1 **L-9, T-3**

FUNDAMENTALS OF DISCRETE-TIME SIGNALS AND SYSTEMS: Concepts of system, signal. Sampling Process. Impulse Response. Z-Transform, Discrete Transfer function, Discrete Fourier Transform(DFT), Fast Fourier Transform(FFT), Medical Applications.

UNIT - 2 **L-9, T-3**

ELECTROENCEPHALOGRAM(EEG): Applications, Signal Processing, Modeling and Artifacts. Nonparametric and Model-based spectral analysis, EEG segmentation, Joint Time-Frequency Analysis; Evoked Potential Modalities, Noise Characteristics, Noise reduction by Ensemble Averaging and Linear Filtering, Single-Trail Analysis and adaptive Analysis Using Basis Functions.

UNIT - 3 **L-9, T-3**

WAVELETS: Continuous Wavelet Transform, Discrete wavelet transform, Reconstruction; Recursive multi resolution decomposition; Types of wavelets-Haar wavelet, Daubechies wavelet, Biorthogonal wavelet, Coislet wavelet, Morlet wavelet, Mexican Hat wavelet, Symlet wavelet; Medical applications.

UNIT - 4 **L-9, T-3**

ELECTROMYOGRAM (EMG): The electrical Activity of Muscles, Amplitude Estimation in the surface EMG, Spectral Analysis of the surface EMG, Conduction velocity Estimation, Modeling the EMG, EMG Signal Decomposition

UNIT - 5 **L-9, T-3**

ELECTROCARDIOGRAM(ECG): Heart Rhythms, Heart beat Morphologies, Noise and Artifacts, Baseline Wander, Power line interference, Muscle Noise Filtering, QRS Detection, Wave Delineation, Data Compression, Heart Rate Variability, Acquisition and RR Interval conditioning, Spectral Analysis of Heart Rate Variability.

LABORATORY EXPERIMENTS

Course outcomes:

The student will be able to:

- write a program on digital signal processing algorithms using MATLAB.
- write programs on a DSP chip for a variety of real-time signal processing applications.
- use the FFT in a variety of applications including: signal analysis, fast convolution, spectral and temporal interpolation and filtering.
- choose and design digital filters.

LIST OF EXPERIMENTS: Total Hours-30

1. Use of DSP processors-6X and 2X series for

   (i) Generation of basic signals.

   (ii) Linear and circular convolution

   (iii) Realization of FIR and IIR filters

   (iv) Finding DFT and IDFT of given sequence

   (v) Plotting the power spectral density.

2. Computation of convolution and correlation sequences.

ACTIVITIES:

- *Determine windowing, filtering spectral analysis.*
- *Wavelet transformation, time frequency and classification.*
- *Noise characterization.*
- *Estimation of power spectral density non stationery signal processing techniques.*

3. Signal averaging improvement in the SNR Using coherent and incoherent averaging.
4. Exponential averaging.
5. Data polishing: mean and 0trend removal
6. Design of IIR and FIR Filter
7. PSD Estimation
8. AR Modeling for Predictive Filters
9. LMS Based Algorithm for Adaptive Noise Canceling
10. Data Compression Techniques: AZTEC, TP, CORTES, KL Transform
11. Template matching algorithm for QRS detection
12. Classification of EEG waves.

TEXT BOOKS:

1. Leif Sornmo and Pablo Laguna, “Bioelectrical Signal Processing in Cardiac and Neurological Applications”, 1st edition, Academic Press, 2005.
2. Willis J. Tompkins, “Biomedical Digital Signal Processing”, 1st edition, Prentice-Hall, 1993.

REFERENCE BOOK:

1. Rangaraj M. Rangayyan, Akay Metin(Editor), “Biomedical Signal Analysis: A Case Study Approach”, 2nd edition, Wiley Interscience, 2001.