**IV B.Tech – I Semester**
**(17EC732) BIO-MEDICAL SIGNAL PROCESSING**
**(Professional Elective-3)**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 40 | 60 | 100 | 3 | 1 | - | 3 |

**Pre-Requisites: Bio Medical Engineering, Digital Signal Processing**

**Course Objectives:**

- Describe the origin, properties and suitable models of important biological signals such as ECG and EEG.
- Introduce students to basic signal processing techniques in analyzing biological signals.
- Develop the mathematical and computational skills relevant to the field of biomedical signal processing
- Develop a thorough understanding on the basics of ECG signal compression algorithms.
- Increase the student‘s awareness of the complexity of various biological phenomena and cultivate an understanding of the promises, and challenges of the biomedical engineering

**UNIT-I: Neurological Signal Processing**
The Brain and its potentials; The Electrophysiology origin of brain waves; the EEG Signal and its characteristics; EEG analysis; Linear prediction theory; The autoregressive (AR) method; Transient detection and elimination-the case of epileptic patients.

**UNIT-II: Adaptive Filter and Algorithm**
A Review of the Wiener filtering problem; Principle of an adaptive filter; Steepest – descent algorithm; Windrow-Hoff least –mean-square adaptive algorithm.

**UNIT-III: Data Compression Techniques**
Lossy and Lossless data reduction Algorithms. ECG data compression using Turning point, AZTEC, CORTES, Huffman coding, vector quantization, DICOM Standards.

**UNIT-IV: Cardio logical Signal Processing**
Pre-processing, QRS Detection Methods, Rhythm analysis, Arrhythmia Detection Algorithms, Automated ECG Analysis, ECG Pattern Recognition. Adaptive Noise Cancelling: Principles of Adaptive Noise Cancelling, Adaptive Noise Cancelling with the LMS Adaptation Algorithm, Noise Cancelling Method to Enhance ECG Monitoring, Fetal ECG Monitoring.

**UNIT-V: Signal Averaging, Polishing**
Mean and trend removal, Prony’s method, Prony’s Method based on the Least Squares Estimate, Linear prediction, Yule–Walker (Y –W) equations, Analysis of Evoked Potentials.

**UNIT-VI: Neurological Signal Processing**
Modeling of EEG Signals, Detection of spikes and spindles Detection of Alpha, Beta and Gamma Waves. Auto-Regressive (A.R.) modeling of seizure EEG. Sleep Stage analysis, Inverse Filtering, Least squares and polynomial modeling.

**Course Outcomes:**

After successful completion of the course, the students can be able to:

| S. No | Course Outcome | BTL |
|---|---|---|
| 1. | Understand the fundamental techniques & applications of digital signal processing with an emphasis on biomedical signals. | L2 |
| 2. | Implement algorithms based on discrete-time signals | L3 |
| 3. | Understand circular and linear convolution and their implementation in DFT and analyze signals. | L2 |
| 4. | Understand efficient computation techniques such as DIT and DIF FFT Algorithms. | L2 |
| 5. | Design FIR filters using digital IIR filters by designing prototype analog filters and then applying analog to digital conversion | L6 |

**Correlation of COs with POs & PSOs:**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | | | | | - | - | - | - | - | - | - | | | |
| CO 2 | | | | | - | - | - | - | - | - | - | | | |
| CO 3 | | | | | - | - | - | - | - | - | - | | | |
| CO 4 | | | | | - | - | - | - | - | - | - | | | |
| CO 5 | | | | | - | - | - | - | - | - | - | | | |
| CO6 | | | | | - | - | - | - | - | - | - | | | |

**Text Books:**


1. Reddy D C. “Modern Biomedical Signal Processing – Principles and Techniques”, New Delhi, 2005
2. Akay M. “Biomedical Signal Processing”, Academic press, California,1994.
3. Tompkins W J “Biomedical Signal Processing”, Prentice hall of India, New Delhi, 1999.
4. Bronzino J D “The Biomedical Engineering handbook”, CRC and Free press, Florida, 19


**Reference Books:**


1. Weitkunat R, “Digital Bio Dignal Processing”, 1991, Elsevier.
2. Arnon Cohen “Biomedical Signal Processing” Crc Pr I Llc; 2nd edition, May, 2002.