III Year II Semester	L	T	P	C
Code: 20EC6751	3	1	0	4

BIO MEDICAL SIGNAL PROCESSING

Course Objectives:

1. To understand various Bio-medical signals and signal conversion.
2. To understand the concept of signal averaging and polishing.
3. To understand various lossy and loss-less data compression techniques.
4. To give idea on Cardio logical signal processing.
5. To give idea on Neurological signal processing.

UNIT I: Introduction to Biomedical Signals

The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis. Electrocardiography: Basic electrocardiography, ECG leads systems, ECG signal characteristics. Signal Conversion: Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversion circuits.

UNIT II: Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging. **Adaptive Noise Cancelling:** Principal noise canceller model, 60-Hzadaptive cancelling using a sine wave model, other applications of adaptive filtering.

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: Neurological Signal Processing

The Brain and its potentials; The Electrophysiology origin of brain waves, EEG Signal and its characteristics, Modeling of EEG Signals, EEG analysis, Linear prediction theory, Detection of spikes and spindles Detection of Alpha, Beta and Gamma Waves. Auto Regressive (A.R.) modelling of seizure EEG. Transient detection and elimination-the case of epileptic patients, Sleep Stage analysis, Inverse Filtering, Least squares and polynomial modelling.

Course Outcomes:

A student who successfully fulfils this course requirement will be able to:

S. No	Course Outcome	BTL
1.	Learn various Biomedical signals and signal conversion circuits.	L2
2.	Understand the concept of signal averaging and polishing.	L2
3.	Learn various lossy and loss less data compression methods.	L2
4.	Understand various Cardio logical signal processing methods.	L2
5.	Understand various Neurological signal processing methods.	L2

Correlation of Cos with Pos & PSOs:

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

Text Books:

1. Reddy D C. “Modern Biomedical Signal Processing – Principles and Techniques”, TMH, 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, 1995.

Reference Books:

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