Course Code	Course Title	L	T	P	C
1156EC417	BIOMEDICAL SIGNAL PROCESSING	0	0	0	2

a) Course Category

Independent Learning – Self Learning Course

b) Preamble

This course covers the fundaments techniques most commonly used for the analysis of biomedical signals and concrete examples of their application for diagnosis purposes. The topics covered in the course include are data acquisition techniques, filtering in time domain and frequency domain, optimum and adaptive filtering techniques and event detection methods

c) Prerequisite

Discrete Time Signal Processing

d) Related Courses

Signal Processing Techniques for Speech Recognition

e) Course Outcomes

Upon the successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Explain the data acquisition techniques.	K2
CO2	Discuss filtering techniques for removal of artifacts in time domain	K2
CO3	Discuss filtering techniques for removal of artifacts in frequency domain	K2
CO4	Explain adaptive filtering techniques	K2
CO5	Describe the methods of event detection	K2

f) Course Content

UNIT I Data Acquisition

Cardiovascular system – Electrocardiogram – ECG data acquisition – Lead Configuration – Electroencephalogram – EEG data acquisition – Lead Configuration – Electromyogram - EMG data acquisition

UNIT II Filtering for removal of artifacts

Random noise, structured noise, and physiological interference, High-frequency noise in the ECG, Motion artifact in the ECG, Power-line interferences in ECG signals, Time-domain filters - Moving-average filters - Derivative-based operators to remove low-frequency artifacts

UNIT III Frequency-domain filters

Removal of high-frequency noise - Butterworth low pass filters – Removal of low-frequency noise - Butterworth high pass filters - Removal of periodic artifacts: Notch and comb filters

UNIT IV Adaptive filters

Adaptive filters for removal of interference - The adaptive noise canceller, The least-mean-squares adaptive filter - Removal of artifacts in the ECG - Optimal filtering - The Wiener filter

UNIT V Event detection

Detection of events and waves - Derivative-based methods for QRS detection - The Pan-Tompkins algorithm for QRS detection - Detection of EEG rhythms

g) Learning Resources

Reference Books

1. http://lehre-svn.emsp.tu-berlin.de/Evicab/
2. https://nptel.ac.in/courses/108105101/3