GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3724118
Semester – II
Subject Name: Biomedical Signal Processing

Type of course: Program Specific Elective

Prerequisite: Basic knowledge of Signal and Systems and Digital Signal Processing

Rationale: The course aims at providing the students with the knowledge and methodology for extracting useful information from a biomedical signal, interpret the results and validate the descriptors obtained in the light of knowledge of the biological system involved, produce innovation within the scope of the improvement of physiological knowledge; implement basic and advanced signal processing and pattern classification techniques

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Acquisition, Generation of Bio-signals, Origin of bio-signals, Types of bio-signals, Study of diagnostically significant bio-signal parameters	04
2	Electrodes for bio-physiological sensing and conditioning, Electrode-electrolyte interface, polarization, electrode skin interface and motion artefact, biomaterial used for electrode, Types of electrodes (body surface, internal, array of electrodes, microelectrodes), Practical aspects of using electrodes, Acquisition of bio-signals (signal conditioning) and Signal conversion (ADC's DAC's) Processing, Digital filtering	08
3	Biomedical signal processing by Fourier analysis, Biomedical signal processing by wavelet (time frequency) analysis, Analysis (Computation of signal parameters that are diagnostically significant)	07
4	Classification of signals and noise, Spectral analysis of deterministic, stationary random signals and non-stationary signals, Coherent treatment of various biomedical signal processing methods and applications.	07
5	Principal component analysis, Correlation and regression, Analysis of chaotic signals Application areas of Bio–Signals analysis Multi resolution analysis (MRA) and wavelets,	08

	Principal Component Analysis (PCA), Independent Component Analysis (ICA)	
6	Pattern classification–supervised and unsupervised classification, Neural networks, Support vector Machines, Hidden Markov models. Examples of biomedical signal classification examples.	08

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks (100)					
R Level	U Level	A Level	N Level	E Level	C Level
10	**30**	**30**	**20**	**5**	**5**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

[1] W. J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall, 1993.
[2] Eugene N Bruce, "Biomedical Signal Processing and Signal Modeling", John Wiley & Son's - publication, 2001.
[3] Myer Kutz, "Biomedical Engineering and Design Handbook, Volume I", McGraw Hill, 2009.
[4] D C Reddy, "Biomedical Signal Processing", McGraw Hill, 2005.
[5] Katarzyn J. Blinowska, Jaroslaw Zygierewicz, "Practical Biomedical Signal Analysis Using MATLAB", 1st Edition, CRC Press, 2011.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand different types of biomedical signal.	30 %
CO-2	Identify and analyze different biomedical signals.	30 %
CO-3	Find applications related to biomedical signal processing	40 %

List of Experiments / Assignments:

- Implementation of filter for noise removal
- Biomedical signal processing by Fourier analysis
- Implementation of Spectral analysis of signals
- Biomedical signal processing by wavelet analysis
- Implement Principal Component Analysis (PCA) on given data set
- Perform Independent Component Analysis (ICA)
- Implement Neural networks for classification
- Design a classifier using Support vector Machines

Major Equipment:

Computational lab or facility with the following software or their equivalent:

(1) MATLAB
(2) Python

List of Open Source Software/learning website:

(1) NPTEL Video lectures
(2) SciLab