GUJARAT TECHNOLOGICAL UNIVERSITY

M.E. - Instrumentation and Control

(Applied Instrumentation)

Semester: II

Subject Name: Biomedical Signal Processing

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8.	**Analysis of nonstationary Signals :** 8.1 Problem Statement 8.2 IIlustration of the Problem with Case-studies 8.2.1 Heart Sounds and murmurs 8.2.2 EEG rhythms and waves 8.2.3 Articular cartilage damage and knee-joint vibrations 8.3 Time-variant System 8.3.1 Characterization of nonstationary signals and dynamic system 8.4 Fixed Segmentation 8.4.1 The Sort-time Fourier transform 8.4.2 Consideration in sort-time analysis 8.5 Adaptive Segmentation 8.5.1 Spectral error measure 8.5.2 ACF distance 8.5.3 The generalized likelihood ratio 8.5.4 Comparative analysis of the ACF, SEM and GLR Methods 8.6 Use of Adaptive Filters for Segmentation 8.6.1 Monitoring the RLS filters 8.6.2 The RLS lattice filters 8.7 Application : Adaptive Segmentation of EEG Signals 8.8 Application : Adaptive Segmentation of PCG Signals 8.9 Application : Time Varying Analysis of Heart-rate Variability
9.	**Pattern Classification and Diagnostic Decision** 9.1 Problem Statement 9.2 IIlustration of the Problem with Case-studies 9.2.1 Diagnosis of bundle-branch block 9.2.2 Normal or ectopic ECG beat ? 9.2.3 Is there an alpha rhythm 9.2.4 Is a murmur Present ? 9.3 Pattern Classification 9.4 Supervised Pattern Classification 9.4.1 Discriminant and decision functions 9.4.2 Distance Functions 9.4.3 The nearest-neighbour rule 9.5 Unsupervised Pattern Classification 9.5.1 Cluster-seeking methods 9.6 Probabilistic Models and Statistical Decision 9.6.1 Likelihood functions and statistical decision 9.6.2 Bayes classifier for normal pattern 9.7 Logistic Regression Analysis 9.8 The training and Test Steps 9.8.1 The leave-one-out method 9.9 Neural Networks 9.10 Measures of Diagnostic Accuracy and Cost 9.10.1 Receiver operating characteristics 9.10.2 McNemar's test of symmetry 9.11 Reliability of Classifiers and Decision 9.12 Application : Normal Versus Ectopic ECG Beats 9.13 Application : Application Detection of Knee-joint Cartilage Pathology

Suggestive List of Experiments:

1. Filter the noisy ECG signal using different filters realized through MATLAB or suitable software
2. Develop a MATLAB program to perform synchronized averaging.
3. Develop different methods for selecting QRS complex from the ECG signal.
4. Select QRS complex from the ECG signal for use as the template and use a suitable threshold on the cross-correlation function for beat detection
5. Design a Wiener filter to remove the artifacts in the ECG signal
6. Develop a program to derive the envelogram
7. Develop a program to compute the RMS value at each instant for the EMG signal
8. Compute the PSDs of a few channels of the EEG using Welch's procedure

Reference Books:

1. Biomedical Signal Analysis, A Case Study Approach by Rangaraj M. Rangayyan, IEEE Press Series on Biomedical Engineering, John Wiley & Sons,INC.