

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**ME - SEMESTER-I(New course)• EXAMINATION – WINTER- 2015**

**Subject Code: 2713109****Date: 02/01/2016****Subject Name: Biomedical Signal Processing****Time: 2:30 pm to 5:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Give example of concurrent, coupled and correlated process with in human body. Explain any two examples in details. **07**
- (b) Explain following terms: **07**
- Test of randomness
  - Ensemble averages
  - Covariance of signals
- Q.2** (a) How synchronize averaging of signal will improve SNR? **07**
- (b) Draw signal flow graph of moving average filter and hanning filter. Write differential equation of both. **07**
- OR**
- (b) explain the various types of artifacts that corrupt biomedical signals and explore Filtering techniques to remove them without degrading the signal of interest. **07**
- Q.3** (a) Explain design of filter to remove low-frequency noise or base-line wander without distorting the QRS complex of ECG. **07**
- (b) Explain following terms: **07**
- Form factor
  - Estimation of the autocorrelation function
  - The periodogram
- OR**
- Q.3** (a) Explain designing of the wiener filter. **07**
- (b) Explain the design concept of Butterworth low pass filter. **07**
- Q.4** (a) How adaptive filter is different than other types of filters? Explain adaptive filter with suitable biomedical application. **07**
- (b) Obtain the coefficients of an FIR low pass filter to meet the following specifications using Blackman Window method **07**
- Stop Band Attenuation >50 dB  
 Pass Band edge frequency 3.4.KHz  
 Transition width 0.6 KHz  
 Sampling Frequency 8 KHz
- OR**
- Q.4** (a) Explain any two method of QRS detection from ECG. **07**
- (b) A band stop filter required to meet following specifications. **07**
- A complete signal rejection at 50 Hz  
 A 3 dB width of notch with  $\pm 5$  Hz  
 Assuming sampling frequency of 500 Hz, obtain transfer function by suitably placing pole-zero.

- Q.5 (a)** Explain application of modelling in biomedical field. Explain all pole model. **07**  
**(b)** Write a short note on neural networks role in biomedical field. **07**

**OR**

- Q.5 (a)** We are given a set of feature vectors with no categorization or classes attached to them. No prior training information is available. How may we group the vectors into multiple categories? **07**

- (b)** 1. Why FIR filter is always stable? **07**  
2. Explain mapping of S plane into Z plane.  
3. A digital filter has transfer function

$$H(z) = \frac{z^2 + 1}{z^2 + 0.81}$$

A digital filter has to reject a 50Hz interface from the input. Find out the sampling frequency

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