Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – SUMMER • 2014

Subject code: 1710407 **Date: 23-06-2014**

Subject Name: Biomedical Signal Processing

Time: 02:30 pm - 05:00 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)**	State and explain various human biomedical signals. Discuss the need and objectives of Biomedical signal processing.	**07**
	(b)	Differentiate between the JPEG and JPEG 2000 standards used for image compression.	**07**
Q.2	**(a)**	Explain the basic structure of a *neuron*. With neat figures explain various EEG rhythms.	**07**
	(b)	With the help of neat figure explain the human cardiovascular and blood circulation system.	**07**
		OR	
	(b)	With neat figures describe the *microelectrodes* and *needle electrodes* used for recording various biomedical signals.	**07**
Q.3	**(a)**	Describe the *Hanning moving average filter* with necessary figures. Discuss its application for biomedical signals.	**07**
	(b)	Which type of filtering action will be offered by the following transfer function? Draw the amplitude and phase response of this filter and state its typical application. $$H(z)=\frac{1-z^{-10}}{1-z^{-1}}$$	**07**
		OR	
Q.3	**(a)**	Design an FIR digital filter using a *rectangular window* to approximate an ideal *low-pass filter* with pass-band gain of unity, cut-off frequency of 1 kHz and sampling frequency of 4 kHz. The length of the impulse response should be 5.	**07**
	(b)	The impulse response of a filter is given by the series of values {3, 2, 1, 0, -1, 0, 0 and 1}. State its transfer function and the difference equation of the output. Draw the pole-zero plot and amplitude response of it.	**07**
Q.4	**(a)**	Enlist and describe, in brief, various methods employed to remove *powerline interference* from an ECG signal.	**07**
	(b)	Describe the usefulness of *wavelet transform* over the Fourier transform and STFT. Explain two applications of wavelet transform for biomedical signals.	**07**
		OR	
Q.4	**(a)**	Explain the *window-based* approach of filter design and briefly describe the *Hamming window* and *Kaiser window* used for designing digital filters.	**07**
Q.4	**(b)**	Describe 10-20 standard system for recording EEG signals. State various applications of the EEG.	**07**

Q.5 **(a)** Find the *principal components (PCs)* of the following dataset: **07**
w = [0.4 1.7 2.3 0.2 1.3 0.7 0.6 1.25 1.5 0.75]; x = [2.5 0.5 2.2 1.9 3.1 2.3 2 1 1.5 1.1]; y = [2.4 0.7 2.9 2.2 3 2.7 1.6 1.1 1.6 0.9].
State the importance of principal component analysis (PCA) in context of biomedical signal processing.

(b) Explain the *least square polynomial smoothing filter* with necessary sketches and describe its applications. **07**

OR

Q.5 **(a)** Explain the concept of *independent component analysis (ICA)* and describe its applications for the biomedical signals. **07**

(b) Explain the *least square polynomial derivative filter* with necessary sketches and describe its applications. **07**

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