Seat No.: _____ *Enrolment No.______*

GUJARAT TECHNOLOGICAL UNIVERSITY

BE SEM-VI Regular Examination May 2011

Subject code: 160305

Subject Name: Bio-Medical Signal Processing

Date: 23/05/2011 **Time: 10.30 am – 01.00 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)** Differentiate between continuous, discrete and digital signals. **07**

(b) Consider an LTI system with input x[n] and output y[n]. When the input to the system is; $x[n] = 5\frac{\sin(0.4\pi n)}{\pi n} + 10\cos(0.5\pi n)$, the corresponding output is; $y[n] = 10\frac{\sin[0.3\pi(n-10)]}{\pi(n-10)}$. Determine the frequency response $H(e^{j\omega})$ and the impulse response h[n] for the LTI system. **07**

Q.2 **(a)** Determine and draw the lattice filter implementation of the following causal all-pole system function: $H(z) = \frac{1}{1+\frac{3}{2}z^{-1} - z^{-2} + \frac{3}{4}z^{-3} + 2z^{-4}}$. Is the system stable? **07**

(b) Write short note on: All-pass system **07**

OR

(b) Write short note on: Minimum phase system **07**

Q.3 **(a)** Consider the design of a lowpass Type I linear-phase FIR filter by means of the Parks-McClellan algorithm. Use the alternation theorem to argue that the approximation must decrease monotonically in the "don't care" region between the passband and the stopband approximation intervals. **07**
Hint: Show that all the local maxima and minima of the trigonometric polynomial must be in either the passband or the stopband to satisfy the alternation theorem.

(b) Design an FIR lowpass filter satisfying the following specifications; **07**
$0.98 < H(e^{j\omega}) < 1.02, 0 \leq |\omega| \leq 0.63\pi,$
$-0.15 < H(e^{j\omega}) < 0.15, 0.65\pi \leq |\omega| \leq \pi,$
by applying a Kaiser window to the impulse response $h_d[n]$ for the ideal discrete-time lowpass filter with cutoff
$\omega_c = 0.64\pi$. Find the values of β and M required to satisfy this specifications.

OR

Q.3 **(a)** With suitable example explain the round-off noise in a second order system **07**

(b) Discuss frequency response for rational system functions **07**

Q.4 **(a)** Discuss the effects of coefficient quantization in FIR systems. **07**

(b) Determine how 2N-point DFT of a real-valued sequence may be computed using N-point FFT algorithm. **07**

OR

Q.4 **(a)** List properties of Discrete Fourier Transform (DFT). Discuss any two DFT properties with example. **07**

(b) Suppose we have two four-point sequences x[n] and h[n] as follows: $x[n] = \cos(\frac{\pi n}{2}), n = 0,1,2,3.$ **07**

$h[n] = 2^n, n = 0,1,2,3.$

Calculate the four-point DFT X[k].

Calculate the four-point DFT H[k].

Calculate $y[n] = x[n] ④ h[n]$ by doing the circular convolution directly.

Q.5 **(a)** Which are the artifacts can be present in EEG signal, and how it can be removed? **07**

(b) Enlist different types of cardiac arrhythmias. How arrhythmias can be detected from ECG signal? **07**

OR

Q.5 **(a)** Explain generalized architectures of DSP processors. List applications of DSP processors. **07**

(b) What is Heart Rate Variability (HRV)? How HRV analysis can be done in Frequency Domain? **07**

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