Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Regular Examination January / February 2011

Subject code: 713104N

Subject Name: Bio-Signal Processing

Date: 03 /02 /2011 **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)** Convert analog filter with transfer function $H(s) = \frac{s+0.1}{(s+0.1)^2+36}$ into a digital filter by means of impulse invariance method. **07**

(b) Determine sequence using inverse Z transform for **07**

I. $X_1(z) = \frac{1-\frac{1}{3}z^{-1}}{1-\frac{1}{9}z^{-2}}$; $|Z| > \frac{1}{3}$ using Direct division method.

II. $X_2(z) = \frac{1-\frac{1}{2}z^{-1}}{1+\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}}$; $|Z| > \frac{1}{2}$ using partial fraction expansion method.

Q.2 **(a)** Explain the Pan-Tompkins QRS detection algorithm in detail **07**

(b) Co-efficients of 3-stage lattice filter are $K_1 = 3/2, K_2 = 1/3$ and $K_3 = 1/3$. **07**
Determine the FIR filter coefficients for the direct form structure.

OR

(b) Discuss various biomedical signals and explain application of signal processing techniques for these signals. **07**

Q.3 **(a)** Design an LPF that approximates **07**

$$H_d(f) = \begin{cases} 1 & 0 \le f \le 1000 \\ 0 & elsewhere \end{cases}$$

Sampling frequency=8000 sps. Impulse response sequence duration limited to 2.5 ms. Apply hamming window function to improve magnitude response of LPF.

(b) Explain the rubber membrane concept using suitable example. **07**

OR

Q.3 **(a)** Perform circular convolution for following two sequences **07**
$x_1(n) = \{1, 0.5, 0, 0\}$ and $x_2(n) = \{0.5, 1, 0, 0\}$

(b) Write a note on design of high-pass integer filters. **07**

Q.4 **(a)** Find $X(k)$ for $x(n) = 2^n$ and N=8 using radix-2 DIT FFT algorithm. **07**

(b) Explain data reduction using AZTEC algorithm. **07**

OR

Q.4 **(a)** Notch filter has transfer function $H(s) = \frac{s^2 + 1}{s^2 + s + 1}$ with frequency 1 rad/sec. Design a digital filter by means of bilinear transformation method with following specifications **07**

I. Notch frequency=60Hz
II. Sampling frequency=960 sps

(b) Describe turning point algorithm in detail. **07**

Q.5 **(a)** Draw and explain flowchart of a program for averaging an ECG signal. **07**

(b) Determine Z-transform of the signal $x_1(n) = 0.4^n u(n)$ and $x_2(n) = -0.4^n u(-n-1)$. Derive conclusion from both frequency domain representation. **07**

OR

Q.5 **(a)** Explain 60-Hz adaptive canceling using a sine wave model. **07**

(b) Write a note on ST-segment analyzer. **07**

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