Reg. No. : | | | | | | | | | | | | |

Question Paper Code: 1215021

B.E. / B.Tech. DEGREE EXAMINATIONS, NOV/ DEC 2024
Fifth Semester
Biomedical Engineering
U20BM501 - BIO SIGNAL PROCESSING
(Regulation 2020)

Time: Three Horus | Maximum:100 Marks

Answer All Questions

PART – A (10 x 2 = 20 Marks)

1. Draw the function k(2t + 3) when x(t) = 1, -0.5< t < 0.5 and 0 otherwise.

2. Compute the IDFT of Y(k) = {1, 0, 1, 0}.

3. Using Bilinear transform obtain H(z) if $H(s) = 1/(1+s)^2$ and the sampling period T = 0.1s.

4. Find the equivalent digital filter H(Z) given the analog filter $H(s) = \frac{A}{s+a}$ using impulse invariant transformation.

5. Define Gibb's phenomenon.

6. Write the Hanning Window function and outline its characteristic features.

7. What are the typical sources of high-frequency noise in electrosurgery?

8. How can a high-pass filter help in ECG cancellation from EMG recordings?

9. Define Rhythmic analysis.

10. How to measure Spectral Error ?

PART – B (5 x 16 = 80 Marks)

11. (a) Derive the odd and even components of the following signals.
(a) $x(t) = \sin(t) + 2\sin(t) + 2\sin 2\,(t)\cos(t)$
(b) $x[n] = \{1,0,-1,2,3\}$
(c) $x(t) = \cos(t)\sin(t) + 2\sin(t) + \cos^2(t)\sin(t)+\cos t$
(d) $x[n] = \{1,2,3,2,1\}$ (16)

(OR)

(b) Compute 8-point DFT of a sequence x[n] = {1, 3, 6, 8, -3, -7, -9, 1}. Use DIT-FFT algorithm. Also compare DIT -FFT and DIF algorithms. (16)

12. (a) For the given specifications

$0.707 \leq |H(e^{j\omega})| \leq 1; \quad 0 \leq \omega \leq \pi/2$

$|H(e^{j\omega})| \leq 0.2; \quad 3\pi/4 \leq \omega \leq \pi$

Plot the magnitude response and design a digital Butterworth filter using Impulse Invariance Method. (16)

(OR)

(b) Given the specification α_p = 3dB; α_s = 16dB; fp = 1KHz; fs = 2KHz ; Solve for H(s) using Chebyshev approximation. (16)

13. (a) Design a filter with $H_d(e^{j\omega}) = \begin{cases} e^{-3j\omega}, & -\frac{\pi}{4} \leq \omega \leq \frac{\pi}{4} \\ 0, & \frac{\pi}{4} \leq |\omega| \leq \pi \end{cases}$,

Using a Hanning window with N=7. (16)

(OR)

(b) A band pass FIR filter of length 7 is required. The lower and upper cutoff frequencies are 3 kHz and 6 kHz respectively and are intended to be used with the sampling frequency of 24 kHz. Determine the filter coefficients using rectangular window. Consider the filter to be causal. (16)

14. (a) Illustrate the working principles of adaptive noise cancellation in bio signal processing, using an example of fetal ECG extraction from maternal ECG. (16)

(OR)

(b) Describe the working principle of an adaptive filter and explain how it can be applied to remove ECG interference from EMG signals. (16)

15. (a) Explain in detail about the QRS detection algorithm. (16)

(OR)

(b) Explain the EEG Transient detection and elimination in epileptic patients and its overall performance. (16)

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