

Printed pages: 02

Sub Code: NEC 011

Paper Id: 131625

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**B TECH**  
**(SEM-VI) THEORY EXAMINATION 2017-18**  
**DIGITAL SIGNAL PROCESSING**

**Time: 3 Hours****Max. Marks: 100**

Note: Attempt all the sections. Assume missing data suitably, if any.

**SECTION-A****1. Attempt all of the following questions: (2×10=20)**

- (a) If  $x(n) = \{6, 5, 4, 3\}$  what will be  $x((2-n))_4$ .
- (b) What is the DFT of  $\delta(n)$ ?
- (c) What is the equation for order of Butterworth filter?
- (d) What is difference between IIR and FIR filter?
- (e) Write Gibbs phenomena.
- (f) Define Time Reversal of a sequence in DFT.
- (g) What is twiddle factor in DFT?
- (h) Write the frequency transformation rule for the conversion of LP to HP filter.
- (i) What is the difference between circular convolution and linear convolution?
- (j) Write the expression for hamming window.

**SECTION-B****2. Attempt any three of the following questions: (3×10=30)**

- (a) Use the 4 point DFT and IDFT to determine circular convolution of the following sequence:

$$x(n) = \{1, 2, 3, 1\}$$

$$h(n) = \{4, 3, 2, 2\}$$

- (b) Determine the 8-point DFT of the following sequence using DIF FFT algorithm:

$$x(n) = \{1, 2, 3, 4\}$$

- (c) Write a short notes on the following:

(i) Butterfly Computation    (ii) Inplace Computation    (iii) Bit reversal

- (d) Use bilinear transformation to convert low pass filter,  $H(s) = 1/s^2 + \sqrt{2}s + 1$  into a high pass filter with pass band edge at 100 Hz and  $F_s = 1$  kHz.

- (e) Design a digital Butterworth filter that satisfied the following constraints, using Impulse invariant Transformation.

$$0.9 \leq H(e^{j\omega}) \leq 1 \quad 0 \leq \omega \leq \frac{\pi}{2}$$

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

**3. Attempt any one of following questions:****(1×10=10)**

- (a) (i)**
- A system function is given as under:

$$H(z) = \frac{(1 + 8z^{-1} + 6z^{-2})}{(1 + 8z^{-1} + 12z^{-2})}$$

realize the system function using ladder structure.

- (ii)**
- State and prove the circular convolution theorem.

- (b)**
- Design a linear phase FIR (high pass) filter of order seven with cutoff frequency
- $\frac{\pi}{4}$
- radian/ sec using Hanning window.

**4. Attempt any one of following questions:****(1×10=10)**

- (a)**
- Determine the circular convolution of the following sequences and compare the results with linear convolution:

$$x(n) = (1, 2, 3, 4)$$

$$h(n) = (1, 2, 1)$$

- (b)**
- The first five point of the 8-point DFT of a real valued sequence are:

{0.25, 0.125 - j0.3018, 0, 0.125 - j0.0518, 0}. Determine the remaining three points.

**5. Attempt any one of following questions:****(1×10=10)**

- (a)**
- The system function of the analog filter is given as :

$$H(s) = \frac{s+0.1}{(s+0.1)^2 + 16}$$

Obtain the system function of digital filter using bilinear transformation which is resonant at  $\omega_r = \frac{\pi}{2}$ 

- (b)**
- Design an FIR filter to meet the following specifications:

Pass band edge = 2 kHz

Stop band edge = 5 kHz

Stop band attenuation = 42 dB

Sampling frequency = 20 kHz

Use Hanning window.

**6. Attempt any one of following questions:****(1×10=10)**

- (a)**
- Obtain the direct form I, direct form II, cascade and parallel form realization for the following system:

$$y(n) = -0.1 y(n-1) + 0.2 y(n-2) + 3 x(n) + 3.6 x(n-1) + 0.6 x(n-2)$$

- (b)**
- Find the inverse DFT of the sequence :

$$X(k) = \{6, -2+j2, -2, -2-j2\}, \text{ using DIT-FFT algorithm.}$$

**7. Attempt any one of following questions:****(1×10=10)**

- (a)**
- What is the different window functions used for windowing? Explain the effect of using different window functions for designing FIR filter on the filter response.

- (b)**
- Derive and draw the flow graph for DIF FFT algorithm for N=8.